Electrical World

The consolidation of ELECTRICAL WORLD AND ENGINEER and AMERICAN ELECTRICIAN.
Published by McGraw Publishing Company, Inc.

Vol. 63 NEW YORK, SATURDAY, MAY 9, 1914 No. 19

Limits on the Rate of Return

At a recent meeting of the Finance Forum of the Young Men's Christian Association in New York Mr. Calvert Townley mentioned what he termed the principal object of regulation of public utilities by the public, namely, limitation of the rate of return. His conclusion was that in its efforts to limit the return the public should not go too far, that it should see that the return permitted is as large as it ought to be. The times are hard for the borrowing corporation. While the public has introduced methods of regulation that tend to keep the rate of return down, the financial markets of the world have exacted higher interest rates. Between the desire of the public to prevent high rates of return and the refusal of investors to advance more money at doubtful or inadequate rates of return, the corporations are in serious danger of not being able to obtain the capital needed for extensions. If the public chooses so to do, it can decide that the rate of return on capital investment already sunk in a property shall be limited to a certain rate. But it cannot decide arbitrarily what rate future capital investment shall earn. It can say what rate it would like to allow, but if it cannot get the capital at that rate it loses the benefit that investment of the capital would give. If it says that bondholders should be content with 5 per cent and they will not buy at better than 6 per cent, those who have the capital desired can dictate the terms on which they will lend it. The public should not deal unfairly with capital that is already sunk in a property and then, only under compulsion, deal fairly with the owners of new capital awaiting investment. If it attempts this, holders of the new capital will be afraid that they will be subjected later to the same treatment that is given to the owners of the initial investment and will withhold their money. If investors withhold their money for a long period of time the effect will be a suspension of all new construction by the companies. Such a result is a grave detriment to the prosperity of a community.

Financing Amalgamation in London

The financing of the plan discussed for amalgamation of the supply of electrical energy in the city of London is a matter of vital concern. It serves to test the economic worth of the scheme. It is natural that the community should wonder what the new undertaking can do in the way of financing itself. The conclusion of Messrs. Merz and McLellan is that, assuming that all the existing generating plants in the central area were under one control, it would pay to shut them down and sell most of the plants and generate all the energy produced in centralized plants on the Thames River. The saving in operating cost is estimated at not less than 18 per cent, or about £170,000 a year, after allowance for all capital charges on new plants and mains. According to the figures submitted, this saving, together with the present sinking funds, would permit the writing off of the existing generating plant by 1931, or in seventeen years. The initial capital outlay required, allowing for growth of demand during the next four years, is stated at between £6,000,000 and £7,000,000. The suggestion is, in effect, that part of the saving in operating cost due to the amalgamation be applied toward amortization of the abandoned plant. In order that disappointment may not follow any overenthusiasm in the advance estimates, it is important that the figures be reviewed with great care and conservatively. The best way of attaining the advantages sought is to recognize that capital losses are unavoidable and that proper provision should be made for them within a reasonable period of years. There should be an agreement between the constituted authorities and the public, and the facts should be clear. This country has much to suggest to London in examples of concentration in energy generation, but it has not dealt as frankly with the public as the London report on the question of abandoned elements of plant cost. The report therefore carries a lesson to central-station managers here.

Telegraphing Photographs

A very interesting group of photographs reproduced electrically over telegraph wires have recently appeared in the columns of the *Elektrotechnische Zeitschrift*, with a description by Prof. Artur Korn. The photographs have been made by a sort of telautographic process. The sending-end portrait is mounted on a revolving cylinder like a phonograph cylinder, and a conducting stylus traces a spiral over it in such a manner that the current transmitted from the stylus to line varies, from moment to moment, with the photographic-layer thickness. At the receiving end a string galvanometer is used to control an intense and focused beam of light incident on the photographically sensitive surface of a similar and synchronously revolving cylinder. The string in the galvanometer carries a minute opaque shutter, so that the intensity of the photographing beam varies, from moment to moment, with the strength of the current received over the line. The freedom of the vibration galvanometer string from inertia enables the process to be applied very rapidly, and with strikingly satisfactory results, as compared with those obtained by older methods.

The Study of Street Lighting

Mr. James R. Cravath's notes on street lighting bring to the front the new problems which have been introduced by recent illuminants. Until within two or three years the introduction of powerful light sources in street illumination implied the use of arc lamps. At the present time, thanks to the nitrogen lamp, this situation is entirely changed, so that the old relations which existed between large and small units with respect to costs have undergone considerable alteration. No one yet knows the effect of these recent powerful incandescent units on the economy of the situation. They are efficient and simple to operate. They do not require trimming in the sense in which even the longest-burning arc lamps require it, and save for the lamps themselves there are no considerable repairs or renewals to be taken into account. Furthermore, even if the economic features of the new lamps were known at the present moment, the situation is liable to sudden change if the price of lamps should be altered, as experience shows is likely to be the case. Nor have the fixtures for nitrogen lamps been so far standardized that one can safely estimate the best spacing and height for the several units. As a matter of fact, the fixtures cannot be standardized successfully until the sizes and shapes of the bulbs for these lamps are also standardized. As Mr. Cravath plainly shows, we are starting out on a new experimental period in which all these relations must be established.

It is a matter for congratulation that some of the problems set out by Mr. Cravath fall within the sphere of action of experimental work projected by the street-lighting committee of the National Electric Light Association. An actual attempt to determine lighting effects over a considerable extent of street by the use of variously arranged illuminants is likely to lead to results possessing at least a direct bearing upon the questions which are now set before the illuminating engineer. Even larger, however, than the purely technical problems thus to be considered are the psychological ones. From the standpoint of the citizens who, in the last resort, pay for street lighting, the effect is as important as the measured amount of illumination or the characteristics of its distribution. It is undoubtedly true that, retaining the same total light flux on the street, one could produce good or bad illumination from either arc or incandescent lamps. Goodness and badness are not to be measured in lux from the standpoint of any knowledge at present available, nor can they yet be defined in terms of any definite specification. Indeed, the same specifications may lead to good lighting in one place and bad lighting in another. It is very noticeable, for instance, that the proposed standard specifications brought forward in England last year would lead to radically different arrangements of the units under British and American conditions.

It is to be hoped that in the work undertaken by the National Electric Light Association particular attention will be paid to that psychological phase of the matter which determines the pleasant or unpleasant impression produced by various methods of lighting upon the man in the street. The facts in the case are not easy to discover, since one has to deal not only with perhaps widely different viewpoints among individuals but also with very intricate and troublesome phenomena of suggestion. It is one matter to provide suitable types of illumination to be observed, and quite another matter to ascertain the spontaneous opinions of observers about them and the definite reasons, if any, upon which these judgments are based. Whatever concrete results may be reached by the N. E. L. A. committee, it is certain that just at the present moment street lighting is in a phase of rapid transition, the result of which cannot yet be safely predicted.

Polyphase Radio Transmitters

Since the polyphase radiotelegraph work of Eisenstein in Russia began, some eight years ago, radio engineers have shown much interest in the use of polyphase current for charging condensers which thereafter discharge to produce electrical oscillations in radiating antenna systems. From the beginning of work in this direction it has been clear that if enough equally displaced phases are used, or if the frequency of each phase is sufficiently great, waves can be radiated in groups at a very high group frequency. It has appeared that by this method, when circuit reactions are minimized and if the regular operation of each phase circuit is assured, it is possible to emit from an antenna radiant energy in a practically unbroken stream.

In the original polyphase transmitter use was made of a plurality of antennas, each being charged in its turn by one phase of the exciting current and then discharging to ground, with oscillations, across its own series spark-gap. Various other schemes have been proposed from time to time, and some have been put into more or less successful operation. In this issue Mr. Edward G. Gage describes a sending apparatus, comprising quenching spark-gaps and a special 6000-cycle, three-phase alternator, with which he has experimented. With this arrangement of instruments it is possible to secure group frequencies as high as 36,000 per second—a value entirely above the upper limit of audibility in telephone receivers. Such radiation has many of the characteristics of sustained waves as produced by a radio-frequency alternator and may be used for wireless telegraphy with receivers intended for continuous wave transmission, or for radiotelephony. In fact, at a wave frequency of 150,000 per second—wave-length 2000 meters—and a group frequency of 30,000, a new wave train will start at about each fifth oscillation, so that if the antenna damping is not unduly high the emitted wave will be practically sustained. It appears that for best results the wave frequency should be chosen an exact multiple of the number of groups per second, for then there will still exist a fixed phase relationship between the last wave of each train and the first of the succeeding group.

The trend of long-distance radiotelegraphy seems to be away from grouped-wave transmission and toward continuous radiation. In radiotelephony arcs producing sustained waves are being abandoned, and in their stead appear various types of spark oscillators capable of creating large numbers of wave groups per second. The multiphase transmitter, as described, may be considered to occupy a middle ground; although its emission is not absolutely continuous, yet its group frequency is far above the minimum of, say, 4000 per second upon which excellent radiotelephonic speech can be transmitted. It seems possible that the flexibility of the apparatus will commend it for many purposes and that the polyphase method or some development of it will find useful application in the near future.

Compulsory Sale of Utilities

As noted in our Digest, the London *Electrician* is opening a discussion of the relations of public utilities to municipalities which promises to bring the facts of the case before the public eye in a way to compel attention. The situation in England is somewhat different from that ordinarily found in this country, but the underlying principles of the relation of utilities to the community are not confined to any one quarter of the world. The point of the matter is that our English friends have experimented with municipal ownership until the whole situation is greatly confused. Beyond doubt some of the British municipal plants have been highly successful, owing to skilful management and especially because of the very limited territory served by the average plant of this kind. There have been many other municipal plants which, if not absolutely and disastrously unprofitable, are struggling along without showing to the taxpayers a very creditable balance sheet. In this respect the situation is simply what is to be expected. That is, when an enterprise is well handled under favorable conditions it succeeds whether publicly or privately owned; if the management is bad and the conditions unfavorable—a situation more likely to arise in the case of a municipal plant than one privately owned—the results are unsatisfactory.

So far as London is concerned, the greater part of the electricity supply is in the hands of private companies, which have spent in the aggregate some $70,000,000 in development. At the present time consideration is being given to a project for wholesale electricity supply throughout the entire district in the interest of economy, and such supply, doubtless, if carried out, sooner or later would take over as customers most of the municipal plants. But there stands before the eyes of British investors a threatening specter in the form of the compulsory sale of their properties seventeen years hence to the London County Council, if it elects to take them over. This situation is of importance to American investors since within late years not a few franchises have been granted for public utilities with similar provisions for purchase incorporated therein. The terms of a liberal franchise seems long from the nearer end, and investors too often think merely of current profits and well-nigh certain growth, without remembering what may happen at the termination of the franchise. The London companies are in a situation where the end looms large, and from their plight investors here may well take warning. The terms of compulsory sale are based on the value of the plant, buildings and mains at the time of purchase, without regard to good will, a specification which has a somewhat familiar sound to American ears. Just what price could be obtained under such an arrangement is uncertain until the courts have passed upon it, but it assuredly is not such a price as the enterprise would bring at private sale to a new group of investors. In most states of our own country there are provisions for municipal ownership by buying out the existing plant on a valuation excluding franchise values. In the few cases where such a purchase has actually been made the value of the plant as a going concern has been maintained high enough to permit the owners to obtain a fair amount of compensation. The British provision is more burdensome and the end is sufficiently near at hand to discourage great activity in building up an investment which must evidently in considerable measure be sacrificed. That phase of the matter was well shown in the taking over of the telephone properties by the British government, the results of which are certainly not encouraging to those who believe in a general public ownership of utilities. What keen interest can the owners of private plants have in a system of unified supply, which might greatly benefit the consumer, if the business must be sold on its physical valuation at the end of a short term of years? The owners would be more than human if they were not tempted so to operate the property as to secure the maximum profits.

The London situation is nearly enough related to our own to be worth critical study. English opinion, indeed, seems to turn favorably toward the recent American rule of commissions as a successful remedy for the disease of deferred and uncertain municipal ownership. It is clear that under American conditions municipal ownership and operation of electric supply is likely to prove disadvantageous—even more so than the activities of the most unwise commission. Municipal partnership as tried in Germany is a possible middle course, yet the results obtained from it have not always been encouraging.

The fundamental purpose either of municipal ownership or municipal and state regulation is to furnish to the consumer the best facilities for supply at a reasonable price. The situation in London is not such as to compass this desirable end finally, and it looks very much as if the American commission system, with all its faults, were a more promising solution of the manifold difficulties. Commissions are learning by experience, and unless the present trend of affairs changes they are likely to end, on the whole, in giving far more nearly proper treatment to all parties than can be obtained by the more drastic methods now threatening supply companies in London.

The News of the Week

Activities and Events in the Electrical Field—Reports of Meetings—Commission Findings, Etc.

Tax Suggested for Water-Power Bill

An annual federal tax of 25 cents per hp on all power developed by hydroelectric corporations on government water-power sites was urged as an amendment to the administration water-power bill on May 4 by Mr. M. O. Leighton, an engineer formerly with the reclamation service. Mr. Leighton appeared before a committee of the House of Representatives.

A. I. E. E. Annual Meeting

The American Institute of Electrical Engineers will hold its regular annual business meeting at the Engineering Societies Building, New York, on Tuesday, May 19, at 8:15 p. m. Following this meeting a technical session will be held, the program for which was arranged by the committee on the use of electricity in marine work. Two papers will be presented, "The Future of Electric Heating and Cooking in Marine Service," by Mr. H. J. Mauger, and "Electricity, the Future Power for Steering Vessels," by Mr. H. L. Hibbard.

Legislation on Trust Regulation

A sub-committee of the committee on interstate and foreign commerce of the Senate has reported the text of the omnibus trust regulation bill to the full committee. The bill represents substantially the legislation on the subject which the committee will recommend to the Senate, although it is, of course, subject to amendment by the full committee. The bill provides for an interstate trade commission with power of supervision over holding companies, issues of securities and interlocking directorates.

On May 2 Chairman Clayton of the committee on the judiciary of the House of Representatives moved a special rule for the consideration of the omnibus trust regulation bill which the committee ordered reported favorably. There are a number of differences between this bill and the bill drafted by the sub-committee of the Senate committee.

Contest Against California Compensation Law

The Great Western Power Company and the Southern Pacific Company are leading an attack upon the compensation law which went into effect in California on Jan. 1, 1914. This law gives a commission practically unlimited authority in the award of damages and the decision on the question of requiring special equipment in manufacturing plants. The companies mentioned, which are taking the initiative in the contest against the law, are prominent exponents of the "safety first" movement, but feel that the new measure is so radical that it is necessary for them to take steps against it. The companies are supported generally in their decision by manufacturers and employees of the State, who fear that the power granted the commission under the law might be abused if political changes should place the control of the commission in other hands.

Disposal of Riverside Plant Recommended

Mr. Joseph H. Cox, general manager of public utilities of Riverside, Cal., has recommended that the city dispose of its existing steam plant. The recommendation is before the Board of Public Utilities for action. The steam plant was installed in 1900 and has been maintained as a reserve supply. The municipality has contracts for electrical energy with the Southern California Edison Company and the Southern Sierras Power Company which will last until 1917, with privileges of renewal. Mr. Cox says that it would be to the interests of the city to sell stock carried for house-wiring purposes to electrical contractors. He believes that this policy would mean that the private contractors would become in effect new-business solicitors for the city.

Convention of National Fire Protection Association

The annual convention of the National Fire Protection Association opened in Chicago Tuesday with an attendance of about 250. One feature of the report of the executive committee was the recommendation which was adopted that no action be taken in relation to changing rules or standards without consulting the manufacturers or others interested. Resolutions were adopted advocating certain measures to prevent fire waste. These measures include the adoption of fire-resistive building construction, the installation of automatic sprinkler systems and the like. The proposal to change the name of the organization to the American Fire Protection Association was deferred for future action. Mr. R. W. Campbell, of Chicago, president of the National Council of Industrial Safety, addressed the convention, as did Mr. Robert Adamson, Fire Commissioner of New York City, and others. New specifications for electric fire pumps were approved.

The Southwestern Association Convention at Galveston

The tenth annual convention of the Southwestern Electrical and Gas Association will be held from May 20 to 23 at Galveston, Tex., with the Hotel Galvez as headquarters. Supplementing the general sessions, at which will be discussed matters of importance to the different utilities represented, separate and distinct sessions have been arranged for gas, for street and interurban railway and for electric light and power companies, with a special session for accountants. The sessions have been planned so as not to interfere one with the other. The papers and discussions will include personal points of view and experiences in connection with a given subject, and among the more prominent features will be a symposium on "Safety First." "Fire

Prevention Versus Fire Protection," "The Public Policy of Public Corporations," "The Practical Side of the Commercial Department" and "Economy in the Use of Power in the Operation of Cars" are some of the subjects that will be discussed. A symposium on rates by specialists in the study of this matter is also scheduled. The Jovians have planned a parade for Friday, May 22, which is to follow the rejuvenation proceedings. Mr. H. S. Cooper, 405 Slaughter Building, Dallas, Tex., is secretary of the association.

Plan for Water-Power Development at Washington

Senator Norris, of Nebraska, has introduced a bill in the Senate as an amendment to the river and harbor bill for the development of water-power on the Potomac River above Washington and for the construction of a power plant to furnish electric light and power for use in the District of Columbia. It also provides for an increase in the water supply for Washington. The amendment authorizes the expenditure of $15,021,600 to meet the expense of the project.

The river and harbor bill is in the Senate commerce committee and will not be completed, it is said, for two weeks. Senator Norris appeared before a sub-committee on May 5 and urged that his measure be inserted in the bill. He told the committee that ultimately the work could be continued so as to supply all the needs of the District of Columbia for light and power.

Annual Meeting of Chicago Section, E. V. A.

At the annual dinner and meeting of the Chicago Section of the Electric Vehicle Association of America Tuesday night officers were elected as follows: Chairman, Mr. W. J. McDowell, of the General Motors Truck Company; vice-chairman, Mr. Louis E. Wagner, of the Baker Electric Sales Agency; secretary-treasurer, Mr. F. E. McCall, of the Commonwealth Edison Company; executive committee, Messrs. H. E. Niesz of the Commonwealth Edison Company, C. B. Frayer of the Edison Storage Battery Company, Harry Salvat of the Fashion Automobile Station and D. C. Arlington of the Philadelphia Storage Battery Company. Mr. Niesz, the retiring chairman, presided at the dinner, and Mr. John F. Gilchrist, of the Commonwealth Edison Company, acted as toastmaster. The report of Mr. McDowell, the retiring secretary, showed the section membership to be 119. Mr. Gilchrist said that five Edison substations in Chicago are now equipped for boosting battery charges as high as 200 amp. Addresses were made by Mr. J. E. Hale, of the Goodyear Rubber & Tire Company, on "Tires," and Mr. D. M. Simpson, of the Electric Storage Battery Company, on "The New System of Constant Potential Charging for Garages." Mr. Frank W. Smith, of New York, president of the national body, made an interesting address in which he said there are now 675 members in the society and seven local sections. He reviewed the work of the association, mentioning the fact that Mr. Alexander, of the General Electric Company, had been secured for chairman of the educational committee and Mr. W. W. Freeman as chairman of the central-station co-operation committee. Mr. Smith dwelt especially on the work of the parcels-post committee under the chairmanship of Mr. J. H. McGraw. New work will be undertaken by the E. V. A. in an attempt to relieve freight terminal congestion through the use of electric trucks co-operating with railroads. Dean H. A. Raymond of the Armour Institute of Technology announced the establishment of a ten weeks' course in fundamentals underlying electric-vehicle operation. This course will be given by Prof. D. P. Moreton and at first will be for night-class students. Armour Institute, he said, is glad to co-operate in this matter with the educational committee of the Electric Vehicle Association. Mr. W. C. L. Eglin, of Philadelphia, made a spirited appeal for co-operation in advancing the electric vehicle.

Special Meeting of the Ohio Electric Light Association

A special meeting of the central-station interests in the State of Ohio was held Wednesday at Columbus, Ohio, under the auspices of the Ohio Electric Light Association to consider the questions of policy involved in obeying the recent order of the Ohio Public Utilities Commission requiring the valuation and appraisal of all public utilities in the State by August 1, for rate-making purposes. The executive committe of the Ohio Electric Light Association met on Tuesday and presented its report at the meeting on Wednesday, which resulted in the appointment of two special committees. About seventy-five central station companies were represented at the meeting, which was presided over by Mr. J. C. Martin, of Wilmington, president of the Ohio Electric Light Association, and Mr. D. L. Gaskill, secretary of the Ohio Electric Light Association, acted as secretary of the meeting.

At the request of the Ohio Public Utilities Commission, a committee on uniform accounting to co-operate with the commission was appointed, as follows: Messrs. L. K. Funkhauser, of Dayton; K. Scobel, of Cleveland; M. Galish, of Cincinnati; R. Stevens, of Youngstown, and F. W. Drager, of the American Gas & Electric Company, New York. The following committee on appraisal was also appointed to co-operate with Ohio central stations in an advisory capacity in making the valuations and appraisals ordered by the commissions: Messrs. F. M. Tait, of Dayton; F. W. Milliken, of the American Gas & Electric Company, New York; Robert Lindsay, of Cleveland; F. K. Gerge, of Toledo, and W. W. Freeman, of Cincinnati.

Both committees will meet during the coming week to organize and to adopt ways and means and plans. They will also act as a clearing house for information for the Ohio central stations in this important matter. Headquarters will be secured in a Columbus office building, where all meetings of both committees will be held.

Developments in Cleveland Rate Case

The initial hearing in the case of the Cleveland Electric Illuminating Company and other companies concerned which have appealed to the Ohio Public Utilities Commission in regard to the 3-cent rate ordinance passed by the City Council of Cleveland is to be held on May 25.

It is expected that the new plant of the city of Cleveland will be in operation about the middle of June. Construction of this plant was started in 1911, and an issue of $2,000,000 bonds was made to meet the cost. This plant is situated at the foot of Fifty-first Street on the shore of Lake Erie, adjoining the water-works. When completed it will have a 24,000-kw equipment. Its principal units consist of three Allis-Chalmers generators of 5000 kw normal and 7500 kw maximum rating. The principal engineering feature about the plant is the boilers, of which there will be six. They

are of the Stirling type, similar to the Delray boilers installed at Detroit.

The city of Cleveland has at present two municipal plants, one in Brooklyn and one in Collinwood, which are former suburbs annexed to the city. From these plants energy is furnished to about 5000 residence and commercial customers and 1500 street lamps. When the Fifty-first Street plant is placed in operation these plants will be closed down and all energy will be supplied from the new plant. The equipment of the two plants will be maintained to furnish service when needed.

The municipal plant will embark in a competitive business. Its rates are fixed by city ordinance at 3 cents per kw-hr. maximum for all classes of service and 1 cent minimum. Energy for residences will be furnished at 3 cents and that for motor service at from 1 cent to 3 cents. The motor-service schedule has been changed since it was first made public. Before these rates were established the city plants charged rates which averaged about 6 cents. This was near the average rate of the local company, which, for residences, is about 6¼ cents. Since the announcement of its new rates the city has secured, it is said, from forty to fifty motor-service customers. The two plants are now fully loaded.

Mr. Stage, director of utilities, declares that contracts issued upon the basis of the schedule originally announced by the city will be recalled and changed. Errors were found in the schedule which would have involved the city in heavy loss, according to the statements made in Cleveland. Officials of the law department of the city are declared to have said that if the holders of the contracts refuse to surrender them, the contracts will be declared legal by the courts.

Bill in Congress Regulating Dams Across Navigable Rivers

A bill to amend the law regulating the construction of dams across navigable rivers has been introduced in the House of Representatives by Congressman Adamson. The bill was referred to the committee on interstate and foreign commerce. It provides that plans for the construction of such dams shall be submitted to the Secretary of War and the Chief of Engineers for their approval. Such conditions may be imposed as they deem necessary.

The approval shall provide the reimbursement to the United States of all expenses incurred with reference to the project and for the payment to the United States of reasonable charges for the benefits which may accrue to the project through the construction, operation and maintenance by the United States of headwater improvements, including storage reservoirs, on any such stream. Such charges are to be fixed by the Secretary of War and the Chief of Engineers and are not to exceed in any one year an amount equal to 5 per cent of the total investment cost in addition to the necessary annual expense of operation of such headwater improvement.

Any grantee who shall fail or refuse to comply with the order of the Secretary of War, made in accordance with the act, shall be deemed guilty of a misdemeanor and on conviction shall be punished by a fine not exceeding $1,000. In addition to such penalty the court may decree a revocation of the rights and privileges held under the act. The right granted shall continue for fifty years from the date of completion of the structure, and after the expiration of the fifty years such rights shall continue until compensation has been made to the grantee for the fair value of the property.

The fair value of the property and the reasonableness and good faith of existing contracts shall be determined by agreement between the Secretary of War and the owners of the property. In the event of failure to agree proceedings may be instituted by the United States or by any person authorized by Congress in the United States District Court. No value shall be claimed or allowed for the rights. In cases where the electric energy generated enters into interstate or foreign commerce the rate for service shall be just and reasonable. In any valuation of the property for rate-making purposes there shall be included the cost of the construction of a lock or locks or other aids to navigation and all other capital expenditures required by the United States. Conflict with state regulation of rates and service is to be avoided if the regulation is not unduly discriminatory against the service or rates in any other states.

Connecticut Get-Together Club

The Connecticut Get-Together Club was formed at a meeting in New Haven, Conn., on May 1, its object being to increase acquaintance and sociability among the men connected with the electrical industry in Connecticut, to increase the membership of the New England Section of the National Electric Light Association, and to bring about instruction in and discussion of ways and means to "do it electrically." Mr. A. J. Campbell, of Waterbury, was elected chairman, and Messrs. W. P. Schwabe, of Thompsonville, and W. R. Hoppen, of New Haven, were elected as members of the executive committee. At a dinner in the Café Mellone preceding the meeting Mr. L. D. Gibbs, of Boston, spoke of the necessity of men connected with the electrical industry getting together. Mr. J. M. Wakeman discoursed on the advantages of co-operative effort and outlined the present plans of the Society for Electrical Development, Inc. Prof. C. F. Scott made an interesting talk upon the Sheffield Scientific School and its work, and Messrs. C. A. Leonard, of Meriden, and Harrison B. Freeman also spoke upon co-operation. Mr. H. E. Page, of Hartford, acted as chairman.

Power Bond Election in Los Angeles

The election over the question of the issue of $6,500,000 bonds for the municipal power development at Los Angeles, Cal., was held on May 8. A telegram to the *Electrical World* on May 7 said that both sides were fighting intensely and that meetings were being held each night in dozens of places throughout the city. A vote of two to one was required to carry the bond issue. Of the total amount of bonds proposed $1,250,000 would be used for completion of the plant and $5,250,000 for construction of a distributing system or for the purchase of the existing system of the Southern California Edison Company by condemnation. The system which it was proposed to purchase by condemnation reaches 45 per cent of the consumers in the city. Of the existing three companies two companies would remain in the field to compete for the rest of the consumers.

In the controversy preceding the election, Mr. J. A. Lighthipe showed that the plant of the city cannot be finished for the amount estimated and that an adequate distributing system cannot be built or acquired for the amount named for that purpose. Mr. E. F. Scattergood, city engineer, admits the insufficiency of the estimate. As the tax burden of the city of Los Angeles is large and the bond limit would be extended if the power bonds are issued, bankers have taken an interest in the

campaign. E. H. Rollins & Sons have warned citizens to vote against the proposed issue. Incidents of the campaign of the last few days are the daily house-to-house canvass made by the Edison company, the distribution of an enormous amount of literature by both sides and the use of entire pages for advertisements in the daily newspapers. It was announced definitely that if the issue of bonds receives the approval of the electorate, the Edison company will carry the condemnation case to the Supreme Court.

Preliminary Program of National Electric Light Association's Convention

A preliminary outline of the work to be done at the convention of the National Electric Light Association at Philadelphia, June 2-5, has been given out by the association. For convenience, the program herewith is divided into general, technical, commercial, hydroelectric and accounting sessions. There is a general session on the morning of June 2, with three simultaneous sessions during the afternoon of that day. Three simultaneous sessions have also been arranged for the morning of June 3. No sessions are scheduled for the afternoon of that day, but during the evening there will be a general and executive session followed by the public policy session at which the report of the public policy committee will be presented. Three simultaneous sessions will be held on the morning of June 4 and two during the afternoon of that day. On June 5 there will be a general session in the morning, after which the convention will adjourn.

General Executive and Public Policy Sessions

Tuesday, June 2, 10 *a. m.*

(1) Welcome to the city. (2) Address of President McCall. (3) Announcements. (4) Report of committee on organization of the industry, by Mr. Holton H. Scott. (5) Report of secretary, by Mr. T. C. Martin. (6) Report of insurance expert, by Mr. W. H. Blood, Jr. (7) Report of committee on progress, by Mr. T. C. Martin. (8) Report on the "Question Box," by Mr. S. A. Sewall. (9) Paper, "Safety First," by Mr. Paul Lupke.

Wednesday, June 3, 8 *p. m.*

(1) Action on report of public policy committee, presented by Mr. Arthur Williams. (2) Presentation of proposed constitutional amendments, by Mr. F. W. Frueauff. (3) Report of treasurer, by Mr. W. F. Wells. (4) Election of nominating committee. (5) Appointment of committee on resolutions. Music.

Wednesday, June 3, 8:45 *p. m.*

Public Policy Session: (1) Reading of report of public policy committee. (2) Address. (3) Music.

Friday, June 5, 10 *a. m.*

(1) Report of committee on award of Doherty medal. (2) Symposium, relations with geographical sections. (3) Report of committee on memorials, by Mr. T. C. Martin. (4) Report of committee on constitutional amendments, by Mr. F. W. Frueauff. (5) Vote on constitutional amendments. (6) Report of committee on resolutions. (7) Report of nominating committee. (8) Election of officers. (9) Adjournment.

Technical Sessions

Tuesday, June 2, 2:30 *p. m.*

(1) Report of committee on meters, by Mr. P. H. Bartlett. (2) Paper, "A New Demand Indicator for Small Consumers," by Mr. R. C. Lanphier. (3) Report of committee on grounding secondaries, by Mr. W. H. Blood, Jr. (4) Report of committee on electric measurements, by Dr. A. E. Kennelly. (5) Address, "The Electric Vehicle," by Dr. C. P. Steinmetz.

Wednesday, June 3, 10 *a. m.*

(1) Report of committee on electrical apparatus, by Mr. L. L. Elden. (2) Paper, "Temperature and Its Relation to the Limiting Capacity of Electrical Apparatus," by Mr. F. D. Newbury. (3) Report of committee on underground construction, by Mr. P. Torchio. (4) Report of committee on overhead-line construction, by Mr. Thomas Sproule.

Thursday, June 4, 2:30 *p. m.*

(1) Report of committee on prime movers, (a) steam, by Mr. I. E. Moultrop; (b) hydraulic, by Mr. J. F. Vaughan. (2) Selection of hydraulic turbines, by Mr. Charles V. Seastone. (3) Report of committee on street lighting, by Mr. J. W. Lieb, Jr. (4) Report of committee on accident prevention, by Mr. M. J. Insull.

Commercial Sessions

Tuesday, June 2, 2:30 *p. m.*

(1) Address of the chairman of the section, by Mr. T. I. Jones. (2) Report of finance committee, by Mr. E. L. Callahan. (3) Report of membership committee, by Mr. J. F. Becker. (4) Report of publications committee, by Mr. Douglass Burnett. (5) Report of committee on education, by Mr. F. C. Henderschott.

Wednesday, June 3, 10 *a. m.*

(1) Report of committee on rate research, by Mr. E. W. Lloyd. (2) Address. (3) Report of lamp committee, by Mr. F. W. Smith.

Thursday, June 4, 10 *a. m.*

(1) Report of committee on non-peak and high-load-factor business, by Mr. G. H. Jones. (2) Report of committee on interurban lighting of highways, by Mr. G. B. Tripp.

Thursday, June 4, 2:30 *p. m.*

(1) Report of committee on wiring of existing buildings, by Mr. R. S. Hale. (2) Report of committee on electrical merchandising and advertising, by Mr. Parker H. Kemble. (3) Report of nomination committee. (4) Election of officers.

Hydroelectric Sessions

Thursday, June 4, 10 *a. m.*

(1) Address of chairman of section, by Mr. W. W. Freeman. (2) Report of committee on hydro-progress, by Mr. T. C. Martin. (3) Paper, "The Nature of Electrical Disturbances in Transmission Work," by Mr. D. B. Rushmore. (4) Report of committee on distributing lines, by Mr. P. M. Downing. (5) Report on permanent methods of measuring water in water-power plants, by Mr. D. W. Mead. (6) Paper, "Water-Power-Plant Economics," by Mr. O. B. Coldwell.

Thursday, June 4, 2:30 *p. m.*

Second hydroelectric session held in conjunction with third technical session.

Accounting Sessions

Tuesday, June 2, 2:30 *p. m.*

(1) Address of the chairman of the section, by Mr. H. M. Edwards. (2) Report of library committee. (3) Report of "Question Box" committee. (4) Paper, "Cost and Statistics," by Mr. T. J. Walsh.

Wednesday, June 3, 10 *a. m.*

(1) Report of committee on uniform system of accounts. (2) Address. (3) Paper, "Variation in Public Service System of Accounting," by Mr. E. C. Scobell.

Thursday, June 4, 10 *a. m.*

(1) Paper, "Accounting for Merchandise Sold," by Mr. H. B. Lohmeyer. (2) Paper, "Suspense Accounts," by Mr. Fred Schmitt. (3) Paper, "Mechanical Sorting and Tabulating Systems," (a) in connection with disbursement accounts, by Mr. F. A. Birch; (b) as applied to inventory of transmission and distribution systems, by Messrs. G. L. Knight and C. V. Woolsey.

Transportation Arrangements

Mr. George W. Elliott, master of transportation, announces four special trains, to be known as the green, brown, golden poppy and magnolia specials. The first will leave Chicago over the Pennsylvania lines on May 31. The second will leave Chicago over the Lake Shore road on May 31, passing over the tracks of the Lehigh Valley Railroad from Buffalo to Philadelphia. The "golden poppy" special will leave San Francisco May 26, making stops at Salt Lake City and Ogden, where the train will be augmented by the Seattle and Pacific Northwest contingent. The Colorado delegation will board the train at Denver, after which the train will proceed to Philadelphia with probable stops at Chicago and Pittsburgh. The "magnolia" special will leave Atlanta, Ga., May 31 over the Southern Railway. In view of the excellent regular train service into Philadelphia from nearby cities, no other specials will be run.

Future Regulation of Public Utilities

Mr. William D. Kerr, director of the Bureau of Public Service Economics, was the speaker at the Finance Forum at the West Side Branch of the Young Men's Christian Association in New York on May 4. His topic was the "Future Regulation of Public Utilities." Mr. Calvert Townley, assistant to the president, Westinghouse Electric & Manufacturing Company, who introduced the speaker, brought up the question of the rate of return. He declared that the principal object of regulation of public utility corporations by the public is to see that the profits are not too great. He emphasized, however, the fact that it is also to the interest of the public to see that the rate of return thus limited be not made too low.

Mr. Kerr described the commission as a clearing house to consider the testimony from the standpoint of the public and the corporations and to decide the issue involved in each case. He showed how capital turns itself over in from four to six years in public utility industries and said that capital must be provided and paid for. The turnover is so infrequent as compared with other classes of business that the charge on consumers to make proper provision for the capital is proportionately large. Mr. Kerr discussed the subject of depreciation at length and explained the necessity of a provision for the retirement of apparatus before it reaches the end of its normal life in many cases. The expense of keeping the plant abreast of the progress of the art must be borne as part of the cost of the service. Mr. Kerr also took up the matter of profits, saying that the men who bring the capital together and put it to the most efficient use must receive an adequate return for their services. Regulation should not deny promoters a profit commensurate with their efforts and risks.

When there was complaint about service of public utilities in the past the idea of the public was to permit a competitive company to get a franchise. The inevitable result of this policy was a duplication of plants and capital investment for which the public had to pay. Mr. Kerr referred to the new municipal plant at Cleveland, saying that there is no expectation that the city will be reimbursed for its investment in this property. It is impossible to compare a plant of this kind with a plant that is responsible to its owners for a return on the investment.

Public ownership is likely to be, and in most cases is, unregulated monopoly, lacking initiative such as characterizes the public utilities under corporate management. As to the future, Mr. Kerr said that the companies must place their cards on the table and show the facts. In the majority of cases the companies are meeting the conditions fairly and working out the problem in an open and honest manner. The intelligence of the public should be represented in the laws creating commissions, and there should be no question as to the authority of the commission to deal with the problem. Men of the right character and standard must find commission service attractive. The alternative to regulation is public ownership. Mr. Kerr said that the judgment of the country for a great many years to come would stand by private operation and ownership.

Mr. Kerr gave data compiled from reports of the Railroad Commission of Wisconsin on the operations of plants in that State. The average cost of plant and property per kilowatt of maximum demand for the following thirteen plants was $510: Oshkosh, Green Bay, Superior, Beloit, Appleton, Milwaukee, La Crosse, Manitowoc, Madison, Janesville, Fond du Lac, Sheboygan and Wausau. The annual fixed charges on these plants at the rates of interest given were: At 10 per cent, $51; at 15 per cent, $76.50; at 20 per cent, $102.

The average cost of plant and property per kilowatt of connected load for the following fifteen plants was $197: Eau Claire, Oshkosh, Beloit, Appleton, Superior, Fond du Lac, Kenosha, Watertown, Janesville, Green Bay, Milwaukee, La Crosse, Madison, Chippewa Falls and Wausau. The annual fixed charges at the rates of interest given were: At 10 per cent, $19.70; at 15 per cent, $28.55; at 20 per cent, $39.40.

The average cost of property and plant per kilowatt-hour generated for the following fifteen plants was 22 cents: Eau Claire, Watertown, Oshkosh, Appleton, Beloit, La Crosse, Janesville, Milwaukee, Fond du Lac, Manitowoc, Madison, Green Bay, Wausau, Sheboygan and Kenosha. The annual fixed charges at the rates of interest given were: At 10 per cent, 2.2 cents; at 15 per cent, 3.3 cents; at 20 per cent, 4.4 cents.

Investments in Mexican Public Utilities

Interest in the public utilities of Mexico is at present aroused owing to the unsettled state of affairs in that unfortunate republic. Contrary to the prevailing impression, the amount of American money invested in the public utilities of Mexico is not very large. To be sure, all the large public utilities are owned by outsiders, but most of the companies have been financed by English capital and are controlled abroad.

The principal public utilities in Mexico are the Mexican Light & Power Company, the Mexican Tramways Company, the Guanajuato Power & Electric Company, the Mexican Northern Power Company, the Sultepec Electric Light & Power Company, the Monterey Railway, Light & Power Company, the Puebla Tramways, Light & Power Company and the Pachuca Light & Power Company. Of these the only ones in which American capital is interested to any extent are the Guanajuato Power & Electric Company, operated in the state of Guanajuato with power plants at El Platanal, El Sabino and El Botella, and the Sultepec Electric Light & Power Company of Toluca, State of Mexico, with power plants at Temascaltepec and San Simonito.

The former company is controlled by the interests associated with W. P. Bonbright & Company, of New York, and operates a large transmission and distribution system. Its power plants are rated at approximately 23,000 hp. Its capitalization consists of $1,500,000 6 per cent preferred stock, $3,500,000 common stock and $3,170,000 bonds. Its gross earnings are about $700,000 a year. It has suffered practically no interruption from the revolution. The Sultepec Electric Light & Power Company is controlled by Brooklynites formerly connected with the Brooklyn Rapid Transit Company, Mr. T. S. Williams being vice-president of the company and Mr. C. L. Rossiter secretary and treasurer. The company has a capitalization of $566,700 and outstanding bonds of $639,000. Its hydroelectric plants are rated at approximately 2500 kw. Its operations have not been affected by the revolution.

The Mexican Light & Power Company, the Mexican Tramways Company and the Pachuca Light & Power Company are controlled by the Dr. F. S. Pearson interests and are financed by English capital. The Mexican Tramways Company has a capitalization of $15,000,000 stock and $8,000,000 bonds. The Mexican Light & Power Company has $19,000,000 common stock, $6,000,000 preferred stock and $21,203,333 in bonds, while the Pachuca Light & Power Company has $4,000,000 in stock and $4,000,000 in bonds. The three companies have earnings of approximately $6,000,000 a year, and while they have continued to operate steadily and have sustained practically no damage, the high rate of exchange and other difficulties have resulted in a suspension of the 7 per cent dividends on their common stocks and on the preferred stock of the Mexican Light & Power Company. The latter has the largest hydroelectric station in Mexico (65,000 kw), situated at Necaxa. From it the city of Mexico is supplied with electricity.

The Mexican Northern Power Company was financed in England and is controlled by interests associated with Sperling & Company, bankers, of England. A hydroelectric development of 25,000 hp was started near Santa Rosalia in the State of Chihuahua in 1910, but owing to the unsettled conditions in northern Mexico and the depredations of the rebels was not completed. The company has $12,600,000 in stock and $10,000,000 in first mortgage bonds. It ceased paying bond interest in 1913 and is now asking the holders to relinquish their interest for two and one-half years and also to authorize the issue of lien bonds to finance the company. The company has brought a suit against S. Pearson & Son, Ltd., contractors, of England, to recover a million dollars damages for alleged failure to carry out the contract to build the Conchos River development, claiming that the contractors stopped work, so that the company itself was compelled to take it over and finish it. The Monterey Railway, Light & Power Company, which controls all the utilities in and around the city of Monterey and also operates the water-works, is owned by the Mackenzie-Mann interests of Toronto. Its capitalization consists of $4,500,000 common, $500,000 preferred and $6,000,000 debenture stock. The Puebla Tramways Light & Power Company is controlled by English interests, headed by Sir C. B. Hyde. It operates all the utilities in the city of Puebla and the surrounding country and owns 44 miles of electric railway and a hydroelectric development rated at 45,000 hp. It has transmission lines to Vera Cruz and to other points. Its capitalization comprises $6,500,000 in stock and $7,349,000 of bonds.

Mexico is a country of many wonderful water-powers, and under normal conditions the hydroelectric possibilities of the country would be rapidly exploited by American and foreign capital.

Convention of Arkansas Association of Public Utility Operators

As announced in last week's issue, the seventh annual convention of the Arkansas Association of Public Utility Operators was held at the Marion Hotel, Little Rock, April 21, 22 and 23. The attendance at the opening session was much larger than at any previous convention. Owing to the removal from the State during the year of Mr. Walter J. Gillette, general manager of the Fort Smith Light & Traction Company, who was elected president of the association at its last meeting, and in the absence of the first vice-president, Mr. E. C. Bellamy, manager of the Mammoth Spring Electric Light & Power Company, the meeting was presided over by Mr. C. M. Richards, manager of the Hope Water & Light Company, second vice-president.

The meeting was opened April 21 by an address of welcome by Mr. C. E. Taylor, Mayor of the city of Little Rock, and the first business session was held that afternoon. The report of the executive committee was submitted by Chairman C. J. Griffith, general manager of the Little Rock Railway & Electric Company, and was followed by the report of the secretary and treasurer, which showed the association to be in good financial condition. A short address was then made by the acting president, Mr. C. M. Richards, following which a paper on "Transformers" was read by Mr. Fred Johnson, district manager of the Wagner Electric Manufacturing Company.

Mr. Byron C. Fowles, treasurer and general superintendent of the Pine Bluff Corporation, reviewed the government statistics pertaining to gas, water, electric-light and street-railway properties. He also dwelt upon the sound financial condition of public utility properties and said they occupy a place among the most substantial investments in the world.

Immediately after the adjournment of the meeting there was a rejuvenation of the Sons of Jove, at which time about thirty members were initiated. In the evening the delegates attended a musical festival.

The Wednesday morning session was opened by Mrs. LaSalle Stoops, president of the Stuttgart Water & Light Company, who made her report as representative of the Arkansas Association of Public Utility Operators to the convention of the National Electric Light Association at Chicago, Ill., in 1913. Mrs. Stoops enjoys the distinction of being the only woman in the United States who operates a combined water and electric company. Her ability as an operator has been demonstrated by the success of her property. She told of the warm welcome she received from the officials of the N. E. L. A. in Chicago.

A paper, "Relation of the Incandescent Lamp to Lighting Service," by Mr. R. E. Campbell, of the National Lamp Works, Cleveland, Ohio, brought out the important factors of voltage regulation from a revenue and operating standpoint. Mr. Campbell recommended separate circuits in residences for electrical appliances.

Mr. H. J. Lehman, secretary of the Citizens' Railway, Light, Water & Gas Company, of Hot Springs, presented a paper on accounting for railway, electric-light, gas and water companies. This paper was discussed by Messrs. W. L. Wood, Jr., manager of the Southwestern Gas & Electric Company, Texarkana; W. J. Tharp, auditor of the Little Rock Railway & Electric Company; R. B. Fowles, auditor of the Pine Bluff Corporation; B. C. Fowles, treasurer and general superintendent of the Pine Bluff Corporation, and C. J. Griffith, general manager of the Little Rock Railway & Electric Company. The secretary was instructed to write to all public utility companies in the State of Arkansas for a copy of their forms pertaining to accounting, so that

any member of the association could at any time examine them. This action was taken with a view to standardizing the accounts of all public utility companies throughout the State so as to conform as closely as possible to the Interstate Commerce Commission forms.

The president was also authorized to appoint an advisory committee, composed of many members in different sections of the State, so that any member within the district may always be able to get in touch with a member of the advisory committee in his section. It was also proposed that this advisory committee act as a membership committee, and start a campaign to try to enlist every central station in the State. The association membership at this time is 103, and there still remain about thirty-five or forty properties in the State not affiliated.

A meeting of the Class B members was held, and Mr. W. R. Herstein, secretary and treasurer of the Electric Supply Company of Memphis, Tenn., was elected president, and Mr. C. R. Croninger, of the General Electric Company's St. Louis office, was elected secretary. The secretary reported an increase of about 20 per cent in Class B membership during the past year.

The afternoon session was opened by a paper on "Modern Methods of Street Lighting," by H. G. Hoke, of the Westinghouse Electric & Manufacturing Company. This paper was discussed very freely, as it was on a subject in which every operator at the meeting was much interested. Numerous lantern slides, showing the various methods of street illumination in cities throughout the country, were shown on the screen.

A paper on "Affiliation of Class A Association to Class B Association," by Mr. L. S. Hunt, general sales manager of the Commercial Electrical Supply Company of St. Louis, Mo., clearly showed the necessity for the affiliation of the different classes of members to make the association a success. A banquet was tendered to the Class A members by the Class B members on Wednesday evening at the Marion Hotel. The usual custom of speechmaking was dispensed with. Mr. C. J. Griffith acted as master of ceremonies.

The only paper presented on Thursday was a joint one on "Increasing the Day Load," by Messrs. A. E. Smith, sales manager of the Little Rock Railway & Electric Company, and Minor Q. Woodward, sales manager of the Pine Bluff Corporation. The authors pointed out many ways for increasing the day load. A very general discussion followed, during which Mr. W. L. Wood, Jr., manager of the Southwestern Gas & Electric Company of Texarkana, informed the association of the results of an "electrical show" which he had in Texarkana. His policy during this show was to give a rebate ticket to the amount of 50 cents, to be applied to lighting bills, with every piece of heating apparatus sold, for each 100 watts of power used by the heating appliance.

The following are the newly elected officers: President, Mr. C. J. Griffith, manager of the Little Rock Railway and Electric Company; first vice-president, Mr. W. L. Wood, Jr., manager of the Southwestern Gas & Electric Company, Texarkana; second vice-president, Mr. H. C. Hoagland, manager of the Fort Smith Light & Traction Company; third vice-president, Mr. H. M. Bowen, manager of the Seven Cities Company of Russellville; secretary-treasurer, Mr. W. J. Tharp, auditor of the Little Rock Railway & Electric Company.

Mr. Charles J. Griffith, the newly elected president, was born in Rochester, N. Y., on Feb. 15, 1865, and was educated in Lafayette, Ind. He engaged in the telegraph business until 1889, when he became associated with the Municipal Light & Power Company, St. Louis, Mo., and the Missouri-Edison Electric Light & Power Company. In 1889 he was associated with the Pine Bluff (Ark.) Water & Light Company. In 1892 he entered the service of the Little Rock Traction & Electric Company, but resigned from that company in August, 1897, to accept a position with the Brown Electric Company, Little Rock, as superintendent of construction. This company constructed an electric light plant for the State of Arkansas to light all of the State institutions at Little Rock. Mr.

PRESIDENT C. J. GRIFFITH

Griffith afterward superintended the installation of the electric light plants in the Peabody and the Cordova Hotels at Memphis, Tenn., and supervised the installation of an electric light plant at Crystal Springs, Miss. In 1899 he became associated with the Southern Engineering Company, St. Louis, Mo., and superintended the installation of the municipal electric light plant at Hastings, Neb., and the electric light and water-works in West Plains, Mo. In 1902 he re-entered the service of the Little Rock Railway & Electric Company as master mechanic and was appointed superintendent of the railway department in 1905 and general manager in 1912.

Merz and McLellan on London Electricity Supply

Much valuable information concerning the electrical-energy systems in London and other large cities of the world was given in appendices of the report of Messrs. C. H. Merz and W. McLellan to the London (England) County Council, mentioned on page 971 of our issue dated May 2, 1914.

In 1912 seventy bodies were authorized to supply electrical energy in the county of London, of which sixty-five were delivering energy from seventy generating stations containing 560 engines having an average output of 550 kw. In the central area of London there are forty-one generating stations exclusive of eight which carry only a traction load and two from which energy is transmitted into the area. The average size of the generating units is 787 kw. Thirty-one systems of generation are in use and eight frequencies.

Statistics relating to capital expenditure on London electricity undertakings are given in Table II. The companies' capital expenditure in Greater London during the last eleven years has averaged £663,687 per year, while the London County Council has sanctioned loans for electricity to the various borough councils amounting to £6,400,000.

Messrs. Merz and McLellan point out that in a number of cities in Great Britain the supply of electrical

energy was first in the hands of private companies, which were bought out at an early stage by the municipality. In America municipal electrical undertakings usually confine themselves to the supply of energy for street lighting, and this practice has been generally followed in Canada. In Australia the supply of electricity in large cities is usually in the hands of the municipalities, while in South Africa both systems of control are about equally used. In newer countries, like those of South America, supply is still in the hands of private companies, as it is in the majority of great European cities. There is a general tendency, however, for municipal authorities to take a closer interest in the supply of electricity, in some cases by acquisition and operation of the private undertakings, but more frequently by acquiring part ownership, or at least insisting on a share in the profits of the private undertakings, as the price of renewing the concession. On the technical side there is a general tendency in all great cities, except London, toward a reduction in the number of controlling concerns and different systems of generating stations. In New York, for instance, the fifteen or twenty systems which existed twenty years ago have now been reduced to four, and the same applies in Boston, Chicago and elsewhere. In Paris the number of utilities has now been practically reduced to one, while in Hamburg and Berlin the supply is in the hands of one company. In Paris the supply will be given hereafter from two stations for the whole of the city, while there is a general tendency evident to reduce the number of stations employed, and greatly to increase their size in all the above-mentioned cities. Table III gives some details of the systems employed in certain of the cities mentioned, and these details are amplified below.

TABLE I—STATISTICS OF STATIONS IN GREATER LONDON —1912

	COUNTY		OUTER LONDON		Total
	Local Authorities	Companies	Local Authorities	Companies	
Total capital outlay	£6,581,198	£14,437,257	£3,267,174	£1,711,770	£25,997,399
Total expenditure on plant and machinery	£1,792,700	£4,651,431	£1,115,573	£499,897	£8,059,601
Total kilowatts connected	137,249	266,510	96,392	23,714	523,865
Total plant installed, kw.	80,603	153,479	53,070	20,186	307,338
Sum of maximum demands, kw	54,474	96,651	31,824	13,772	196,721
Units sold per head of population	21.5	35.5	24.25	11.7	48.5
Kilowatts connected per head of population	0.03	0.06	0.04	0.01	0.07
Average price obtained, all purposes	2.06d.	2.62d.	2.06d.	1.96d.	2.29d.

TABLE II—CAPITAL EXPENDITURE ON STATIONS IN GREATER LONDON

	TOTAL TO DATE		Average per Annum
	1901-2	1912-13	
County of London:			
Local authorities	£2,127,493	£6,853,796	£429,664
Companies	9,053,943	14,613,196	505,387
Total	£11,181,436	£21,466,992	£935,051
Outer London:			
Local authorities	£963,958	£3,198,626	£230,424
Companies	220,072	1,961,366	158,300
Total	£1,184,030	£5,459,992	£388,724
Greater London:			
Local authorities	£3,091,451	£10,352,422	£660,088
Companies	9,274,015	16,574,562	663,687
Total	£12,365,466	£26,926,984	£1,323,775

TABLE III—DETAILS OF SYSTEMS IN THE LARGE CITIES OF THE WORLD

City	Population	Area in Square Miles	Generating Stations.*	Average Size of Generating Stations, in Kilowatts	Kw-hr. per Head of Population	Systems of Generation, Transmission and Distribution
Paris	2,800,000	31	(a) 10 (b) 6	(a) 36,000 (b) 54,000	27 (Sold—Public Supply Cos. only)	Two-phase, forty-two cycles, 12,300 volts, and three-phase, twenty-five cycles, 10,150 volts, transformed to direct current and low-tension alternating current for lighting 2x110 volts, and for traction and power various voltages.
Berlin	2,200,000	24	(a) 6 (b) 3	(a) 25,000 (b) 40,000	111 (Sold—Public Supply Co. only)	Three-phase, fifty cycles, 6000 volts, transformed to direct current 2x240 volts for lighting and 550 volts for tramways; various voltages for power.
Hamburg	1,000,000	30	(a) 4	(a) 11,000	43 (Sold—Public Supply Co. only)	Generation both direct current and at 5000 volts, three-phase transformed to direct current at 2x110 volts for lighting and 550 volts for tramways.
New York	4,754,000	131	(a) 7 (b) 3	(a) 42,000 (b) 94,000	360† (est.)	Three-phase, twenty-five cycles, 6600 volts and 7500 volts, sixty cycles, transformed to continuous and alternating current low-tension supply, at 2x110 volts for lighting; other voltages for power.
Boston	1,051,907	597	(a) 5 (b) 2	(a) 20,000 (b) 49,000	400† (est.) 112 (Edison Co. only)	Three-phase, sixty cycles, 13,600 volts, transformed to single and three-phase 2300 volts and 4000 volts and 115-230 volts, three-wire direct current.
Chicago	2,185,283	191	(a) 7 (b) 3	(a) 47,000 (b) 90,000	425†	Three-phase, twenty-five and sixty cycles, 4500 and 9000 volts, transformed for long-distance transmission to 20,000 volts and for supply to consumers for lighting at 110 volts and 220 volts direct and alternating current and 600 volts direct current for traction.
Detroit	570,000	105	(a) 3	(a) 32,000	330†	Three-phase, sixty cycles, 4600 volts, transformed to low-tension direct current for supply to consumers.
Buenos Aires	1,400,000	60	(a) 7 (b) 2	(a) 16,000 (b) 41,000	123	Three-phase, twenty-five and fifty cycles, 6000 volts and 12,000 volts, transformed to 220x440 volts direct and alternating current.
Greater London	7,252,963	693	(a) 70	(a) 5,400	130† (est.) 48.5 (Public Supply only)	Very various.

*Excluding traction except where traction supply is given by public supply authority.
†These figures represent output for all purposes and from all sources, other than private plants.
(a) Total, including peak, standby and temporary.
(b) Main stations only.

Paris.—Area served, 31 sq. miles. Population, 2,800,000. Supply company, Cie. Parisienne de Distribution d'Electricité. Total kw connected, 226,890

(1912). Total kw-hr. sold, 76,461,411 (1912). Average price obtained, 10.2 cents per kw-hr. (1912).

Berlin.—Area served, 24 sq. miles. Population, 2,200,000. Supply company, Berlin Electricity Works. Total kw connected, 255,721 (1913). Average price obtained, 3.4 cents per kw-hr. (1913).

Hamburg.—Area served, 30 sq. miles. Population, 1,000,000. Supply company, Hamburg Electricity Works. Total kw connected, 99,031. Average price obtained, 6.16 cents per kw-hr.

New York.—Area served, 131.07 sq. miles. Population, 4,754,000. Supply companies: In Manhattan and Bronx, the New York Edison Company and the United Electric Light & Power Company, both controlled by the Consolidated Gas Company; in Brooklyn, the Edison Electric Illuminating Company and Flatbush Gas Company. Kilowatts connected: New York Edison Company, 594,334; United Electric Light & Power Company, 58,697; Edison Illuminating Company of Brooklyn, 122,620; Flatbush Gas Company, 7,031. Average price obtained, New York Edison Company, 5.2 cents per kw-hr.

Boston.—Area served, 597 sq. miles. Population, 1,051,907. Supply company, the Edison Electric Illuminating Company; also three small companies not included in following particulars. Total kw connected, 175,146. Average price obtained, Edison company, 5.4 cents per kw-hr.

Chicago.—Area served, 191.3 sq. miles. Population, 2,185,283 (1910 census). Supply company, Commonwealth Edison Company. Total kw connected, 545,235 (1912). Average price obtained, including charges for special services rendered by the company to their consumers, 2.18 cents per kw-hr. (including traction).

Detroit.—Area served, 105 sq. miles. Population, 570,000. Supply company, Detroit Edison Company, except for public lighting and municipal purposes, which are supplied by municipal plant. Total kw connected, 184,000 (approximately). Average price obtained, 2.86 cents per kw-hr. (approximately).

Buenos Aires.—Area served, 60 sq. miles. Population, 1,400,000. Supply company, La Compañia Alemana Trasatlantica de Electricidad and La Compañia Italo-Argentina de Electricidad. Total kw connected, 265,000. Average price obtained, 5.5 cents per kw-hr.

Steam Turbines Versus Gas Engines for Steel-Mill Power Plants

At a joint meeting of the Chicago Section, American Institute of Electrical Engineers, and the Electrical Section of the Western Society of Engineers on April 27, Mr. F. G. Gasche, of the Illinois Steel Company, Chicago, delivered an address entitled "Power Problems in Steel Mills." Grouping the facts in his talk under three general subdivisions, namely, the laws of thermodynamics, direct commercial problems, and serviceability of the equipment, Mr. Gasche endeavored to show that for steel-mill operation gas engines have never been able to give the satisfactory results obtainable with steam turbines for driving alternating-current generators.

Basing his statement upon experience with a station containing several 2000-kw gas-engine-driven units and upon recently published steam-turbine data, the speaker said that steam turbines showed a rate of fuel consumption that was 37 per cent higher than the rate for gas engines operating under the same load conditions. Claims have been made that steam turbines use two and one-half times the amount of fuel consumed by gas engines, but these statements, made by gas-engine exponents, said Mr. Gasche, are without foundation in fact.

Taking up the commercial side of the problem, the speaker said that a gas-engine installation for steel mills would cost approximately $100 per kw, while a steam-turbine installation of the same character would cost about $55 per kw. Assuming a fuel cost of 0.003 cent per kw-hr. and 6000 hours' annual service, the fuel cost per kilowatt for the steam turbine would amount to $18 annually, while gas engines could produce the energy for $13.10 a year. This shows a saving of $4.90 in favor of the gas engine. However, taking the fixed charges on both plants at 15 per cent, the annual charge per kilowatt would be $8.25 for the steam engine and $15 for the gas engine, showing in this instance $6.75 saving in favor of the steam-turbine installation. Balancing the fixed charges against the fuel cost shows that, considering fixed charges and fuel only, a saving of $1.85 per kw per annum exists in favor of the steam-turbine installation. Consideration of operating expense and other items, said the speaker, will widen this margin considerably.

From lantern slides of crank-effort diagrams Mr. Gasche contended that the inherent features of the gas engine made it necessary for the rotating masses of an installation to drag the heavy reciprocating parts of a gas engine when heavy and quickly fluctuating loads were to be carried. He said further that flywheels large enough to eliminate the difficulty are "commercially and physically preposterous." In spite of the often-discussed high thermal efficiency of the gas engine, the speaker said that the mechanical efficiency of the double-tandem gas engine at fractional loads has proved a disappointment, while even at full load this efficiency is seldom as high as 85 per cent. The great friction load affects operation at fractional load to such an extent, according to Mr. Gasche, that a plant operating with 70 per cent load-factor will be attended with an over-all thermal efficiency of not more than 16 per cent.

In closing, the speaker recommended that where large amounts of by-product gas are at hand for power purposes the use of steam boilers and turbines should be resorted to as a means of delivering the energy from the gas to the shafts of alternating-current generators.

Discussion

In discussing the paper, Mr. W. B. Jackson, Chicago, said that, although he had never been able to advise clients to purchase gas engines in place of steam turbines, he believed it no mistake to develop the gas engine, as it was a step away from the steam cycle and might lead to developments of economic importance.

Mr. Taliferro Milton, Chicago, speaking of speed regulation in steel-mill power plants, told of an installation of storage batteries in a large mill which were used to aid gas engines in carrying fluctuating loads. Mr. Milton said that the Electric Storage Battery Company stands ready to guarantee storage-battery installations to take up the fluctuating load and regulate the speed of the prime movers until within 6 per cent above and below normal. The charge for maintenance and depreciation on such batteries, he said, would be less than 6 per cent.

Mr. E. W. Allen, Chicago, said that the product from steel mills operated with steam-power plants was better than that from gas-engine-driven stations on account of the better speed regulation of the former. He said further that the cost of necessary storage-battery equipment was prohibitive.

Mr. Wilfred Sykes, Pittsburgh, Pa., in commenting upon flywheel action in connection with gas-engine-driven units, said that the addition of heavy flywheels to such a system aggravated peak-load troubles.

Mr. O. H. West, Gary, Ind., in speaking of the advantages of gas-engine-driven stations, pointed out the fact that gas-engine units can be placed in service from standstill in about one and a half minutes. He said further that the energy cost in steel mills driven by gas engine stations was considerably lower than that in steam plants. Others who discussed the paper were Mr. D. W. Roper and Mr. E. B. Waite, Chicago.

Revenues of New York Edison Company

The New York Public Service Commission, First District, has made public a statement regarding the results of operation of the New York Edison Company for the year ended Dec. 31, 1913. The sources of the operating revenues are shown in the accompanying table.

OPERATING REVENUES OF THE NEW YORK EDISON COMPANY

Class of Revenue	Quantity Delivered to Consumers, Kw-hr.	Rate or Average Price, Cents	Total Gross Price
Municipal street lighting—arc	23,554,721	3.25	$766,073
Municipal street lighting—incandescent	1,198,629	7.79	93,395
Lighting municipal buildings—electric (a)	8,487,794	5.02	426,330
Municipal heat and power—electric	283,662	6.00	17,020
Miscellaneous electric revenue—municipal	843,300	10.04	84,649
Commercial metered lighting (b)	261,777,624	6.61	17,310,229
Commercial metered power (c)	28,337,168	7.95	2,252,328
Railroad corporations (d)	124,242,460	.53	659,762
Other electrical corporations (e)	67,040,299	1.32	884,517
Breakdown service (f)	1,808,681	7.34	132,808
Miscellaneous sales of energy (New York City aqueduct)	22,454,439	1.57	352,314
Total from sales of energy	540,028,777	4.26	$22,979,425
Electric merchandise and jobbing revenue			30,944
Joint electric rent revenue			825
Total electric revenues			$23,011,194

(a) Retail, 3,633,287 kw-hr. at $236,985; wholesale, 4,854,507 kw-hr. at $189,345.

	Number of Consumers	Quantity Delivered, Kw-hr.	Total Gross Price
(b) Commercial metered lighting:			
General rate	117,520	169,855,782.8	$13,658,431
Wholesale	471	91,890,301.8	3,649,043
Electrical show	55	5,696.0	171
Prepayment meters	233	25,843.5	2,584
(c) Commercial metered power:			
Motor	13,983	24,840,264.6	2,104,199
Charging vehicles	150	18,038.6	1,804
Storage battery	102	3,478,864.8	146,325

(d) Includes 123,098,460 kw-hr. to Third Avenue Railway Company, for which $636,902 was charged.

	Kw-hr.	Cents	Revenue
(e) Sales to other electric companies:			
United Electric Light & Power Co.	54,906,519	1.32	$725,956
New York & Queens Electric Light & Power Co.	726,580	.55	3,996
Yonkers Electric Light & Power Co.	10,074,044	1.29	130,233
Westchester Lighting Co.	1,333,156	1.83	24,332

(f) Number of contracts, 232; kw-hr. consumed, 1,808,681; total receipts for energy consumed, $132,808, including $36,641 on ninety-eight contracts under which the service charges ($30) were not absorbed in the price charged for energy.

Public Service Commission News

Ohio Commission

While the Public Utilities Commission of Ohio has passed the order providing for valuation of public utilities and interurban railroads, it has allowed several applications in specific cases for extensions of time for filing inventories. Originally the commission expected to require the information to be filed as of April 1, 1914, but later it decided to order that the information requested should be filed on or before Aug. 1, 1914, thus allowing an extension of time amounting to four months for the preparation of the necessary data.

Wisconsin Commission

The decision of the Railroad Commission of Wisconsin fixing a compensation to be paid the Manitowoc Electric Light Company by the city of Manitowoc for the property of the company has been mentioned in the *Electrical World*. The full text of the decision gives data regarding depreciation. A study of forty-two physical valuations of plants varying from one to twenty-four years in age shows the following descriptive data of the ratio of present value to cost new: Minimum, 64.6 per cent; average, 76.6 per cent; medium, 74.7 per cent, and maximum, 97.7 per cent.

California Commission

The Supreme Court of California has rendered a decision reversing the order of the Railroad Commission of California in which permission was denied to the Oro Electric Corporation to supply electrical energy in the city of Stockton. The decision declared that if the State had empowered the city to grant a franchise it also empowered the grantee to exercise the privilege, and that there is nothing to support the contention of the commission that a dual system of control would be created which was never contemplated and that two utilities would be in operation, one under city control, the other under commission control. The court declares that cities have control of their utilities regardless of whether or not they were in operation when the commission was created, and therefore the order denying the Oro company the right to exercise its franchise was outside of the jurisdiction of the commission and null and void.

New York Commissions

The New York Public Service Commission, First District, has granted applications of the New York Edison Company and the Astoria Light, Heat & Power Company to issue additional stock and bonds. Commissioner Eustis broke the deadlock in the commission, voting with Chairman McCall and Commissioner Williams. Commissioners Cram and Maltbie voted no on the questions involved.

The action of the commission authorizes the New York Edison Company to issue $15,800,000 additional capital stock and the Astoria company to issue $5,000,000 of 5½ per cent bonds and $9,500,000 in capital stock.

Commissioner Maltbie took the position that there was not sufficient proof that all of the money borrowed by the Astoria company from the Consolidated Gas Company, which is to be repaid by the issue of securities, was spent on accounts properly chargeable to capital. He also argued that the rate of interest on the Astoria bonds was too high.

Commissioner Eustis filed an opinion in which he explained that he considered the matter of interest rate one for the directors to decide unless there was a chance that the rate charged would increase operating expenses at some future time should a case involving the price to consumers arise.

Current News Notes

"The Jovian."—The name of the monthly journal published by the Jovian Order has been changed from *The Jovian Bulletin* to *The Jovian*. Mr. Ell C. Bennett, 1415 Syndicate Trust Building, St. Louis, is the editor.

* * *

Completion of Shawinigan Development.—The fifth unit has just been installed in power plant No. 2 of the Shawinigan Water & Power Company, Shawinigan Falls, Quebec. The station, which was described in the *Electrical World* of May 4 and May 11, 1912, has a maximum rating of 100,000 hp. The maximum rating of power house No. 1 is 60,000 hp, giving the company 160,000 hp. Outside of the development at Niagara Falls, Ont., that of Shawinigan Falls is the largest at present in operation in Canada.

* * *

Pole Men Exhibit at Forest Products Show.—Representing the twenty-eight company members of the Northern White Cedar Association, formerly the Northwestern Cedarman's Association, an attractive exhibit of white cedar poles and posts was displayed at the Coliseum, Chicago, during the Forest Products Show. Straight, good-looking 25-ft. and 30-ft. poles of standard sizes, with cross-arms and properly guyed, formed the feature of the exhibit. Mr. N. E. Boucher, Minneapolis, Minn., is secretary of the Northern White Cedar Association.

* * *

Jovian Procedure.—A neatly printed "Handbook for Jovian Procedure," written by Mr. Ell C. Bennett, the reigning Mercury, has been published by the Jovian Order. The book consists of a pamphlet of over 100 pages giving information relating to the organization and conduct of rejuvenations and joviations and local Jovian leagues and clubs. The book is interesting to all Jovians and indispensable to statesmen and others who undertake the responsibility of organizing and directing the work of the order in various electrical centers. It is copyrighted by Mr. Bennett for the Jovian Order. The office of Mercury is in the Syndicate Trust Building, St. Louis.

* * *

Ohio State University Electrical Show.—The Ohio State University branch of the American Institute of Electrical Engineers gave a very successful show in the Electrical Building of the University at Columbus, Ohio, April 16, 17 and 18. The building was suitably decorated for the occasion, and forty-eight booths were given over for exhibition purposes. The three local concerns, the Erner & Hopkins Company, the McKeaver Electric Company and the Avery-Loeb Electric Company, each had a large booth at the west end of the building, and the Columbus Railway, Power & Light Company showed a complete line of cooking utensils and household appliances in operation. The spectacular part of the exhibit was in charge of students and comprised an exhibition of 400,000-volt high-frequency current, frying eggs on ice by the aid of hysteresis and eddy currents, etc. About 3000 people attended the show.

* * *

Electric Vehicle Growth in Boston.—Since the Edison Electric Illuminating Company of Boston began its vehicle campaign three years ago there has been an increase of 250 per cent in the number of electrical commercial vehicles in Boston, while the number of electric passenger cars has increased over 110 per cent. The number of cars and garages in Boston on Jan. 1 was 463, there being 208 commercial cars, 255 passenger cars and 185 garages, as compared with 50, 117 and 57 respectively on Jan. 1, 1911. The Edison Electric Illuminating Company of Boston operates the largest fleet of cars, the express companies have nearly fifty trucks and the coal companies more than twenty. The breweries also operate more than twenty trucks.

* * *

SOCIETY MEETINGS

Rejuvenation of Southern California Jovians.—The Jovian Electrical League of Southern California will hold a rejuvenation at Clark's Hotel, Los Angeles, on May 15 at which forty candidates will probably be initiated. At the luncheon held on April 22 District Attorney J. W. Ford delivered an address on the duties and responsibilities of a district attorney.

* * *

Chicago Electric Club Smoker.—About 400 men, comprising members of the Electric Club of Chicago and guests, attended a pleasing entertainment in the Hotel Sherman, Chicago, on the evening of April 29. There was a good vaudeville entertainment, and refreshments were served. Mr. William C. Berry, of the Commonwealth Edison Company, chairman of the entertainment committee of the club, was in charge.

* * *

Value of Associations.—Mr. W. S. Vivian, secretary of the Independent Telephone Association of America, speaking before the Chicago Jovian League on May 4, cited several particular instances in which his association had been of service to its members. In most instances the value of these services repays the annual membership fee many times. Mr. E. C. Lewis spoke on the "Big Brother" movement being carried out under the direction of the Order of Elks and sought to interest Jovians in the work.

* * *

May Meeting of Electric Vehicle Association.—The May meeting of the Electric Vehicle Association scheduled for May 22 will be held in the new auditorium of the Consolidated Gas Company, 130 East Fifteenth Street, New York City. The topic for the evening will be the electric vehicle in parcels-post service for economy and reliability. The general subject will be presented by Mr. G. S. Thompson, Public Service Electric Company, Newark, N. J. Mr. Frank W. Frueauff, chairman of the parcels-post co-operative committee of the National Electric Light Association, will present the workings of his committee, discussing the subject from the viewpoint of the central stations. Mr. James H. McGraw, chairman of the parcels-post delivery committee of E. V. A., will indicate the work accomplished by his committee and show the great influence of the development.

* * *

Meeting of Radio Engineers.—At the May meeting of the Institute of Radio Engineers, which has been postponed until Wednesday, May 13, and is to be held in Fayerweather Hall, Columbia University, Messrs. L. L. Israel and E. J. Simon will present a paper on "The Operating Characteristics of a Three-Phase, 500-Cycle Quenched-Gap Transmitter." In this paper the authors review experiments conducted last November in the New York Navy Yard radio station, together with the observations recorded at the Bureau of Standards and at the Arlington radio station, near Washington. Lantern slides of the apparatus will be shown, and the limitations and possibilities of the system discussed. Mr. John Stone Stone, vice-president of the Institute, will talk on the subject of "The Resistance of the Spark and Its Effect on the Oscillations in the Primary and Secondary Circuits."

Unmarketable Coal Used for Generating Electricity—I

Features of generating station, transmission lines and substations of the Lehigh Navigation Electric Company, Hauto, Pa.—Culm used as fuel with special grates—Water stored for condensing purposes

AT Hauto, Pa., is situated the newly constructed generating station of the Lehigh Navigation Electric Company, which was built by the Lehigh Coal & Navigation Company for the purpose of utilizing the refuse coal from the breakers and washeries where the commercial sizes of anthracite are prepared. Heretofore there has been no profitable market for this refuse coal, although it possesses a fairly high heat value, from 9000 to 11,000 lb.-Fahr. units per lb. On account of the large percentage of coaldust in this refuse it can be burned to advantage only in special furnaces. The cost of transportation of the low-grade material is the same as for the higher grades of anthracite, and consequently the demand for the low-grade coal has been very limited. Provision has been made at the Hauto power station for reducing to a minimum the cost of transportation, as the refuse coal is taken from the breakers and washeries directly to the power-house coal bunkers in gondola cars. The furnaces and grates have been specially designed to burn this refuse coal with a minimum of labor and a maximum of economy. In the production of "stove coal" of commercial sizes the Lehigh Coal & Navigation Company turns out annually enough coal refuse to maintain in continuous operation a 100,000-kw generating plant. The initial capacity of the Hauto power plant is 30,000 kw, and plans are in preparation for the ultimate extension of the plant to 100,000 kw.

The energy which is generated in the Hauto plant is now transmitted to coal mines, cement mills and various other industries in the vicinity, but the entire State of New Jersey and the cities of Philadelphia and New York are within the present commercial limits of electric transmission. The Quaker City is only 73 miles from the station by the shortest route and New York is about 98 miles. The transmission line has been designed for long-distance work, the circuits being run in duplicate to insure uninterrupted service, and a working pressure of 110,000 volts is being employed or has been provided for, except on those circuits supplying electricity in the immediate vicinity of the station.

The station at present is in the shape of a T, the base of which abuts a foothill, and is connected to a railroad track thereon by an elevated steel structure supporting standard-gage tracks. The head of the T contains the generating, switching and transforming equipment, while the stem houses the boilers, which are arranged in a single row beneath the tracks and overhead bunkers. The station exterior is of pleasing design and an unusual amount of window area has been provided to furnish good light and ventilation. An innovation—that of connecting the smoke uptakes with the stacks above the roof instead of inside the building—has also been made in this installation to minimize the cost of the building. While this construction gives a peculiar appearance to the structure, it permits of installing economizers on the roof at any time in the future if desirable.

Coal and Ash Handling

Aside from utilizing the refuse from coal washeries, the striking feature of the plant which makes for economical operation is the method of handling the coal and ashes without the use of conveyors or hoists. Coal is obtained at the washeries near by and is conveyed to the station over an elevated structure in standard-gage 50-ton gondola cars. The tracks enter the building at the rear of the boiler house and extend over each firing

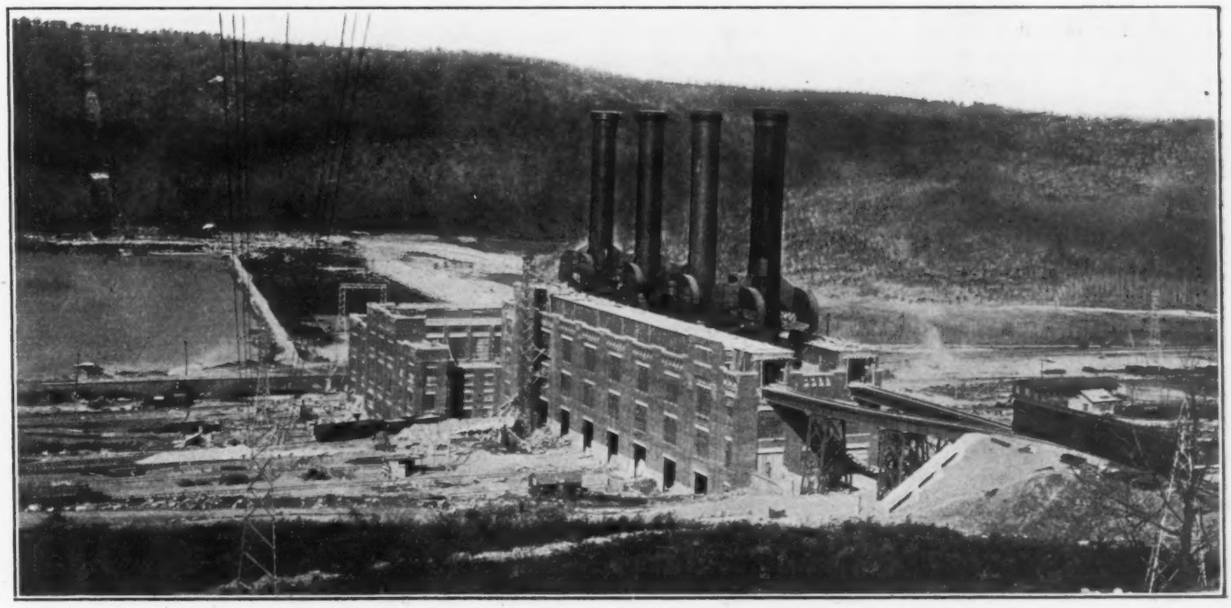


FIG. 1—EXTERIOR OF PLANT, SHOWING STORAGE RESERVOIR AND SMOKE UPTAKES

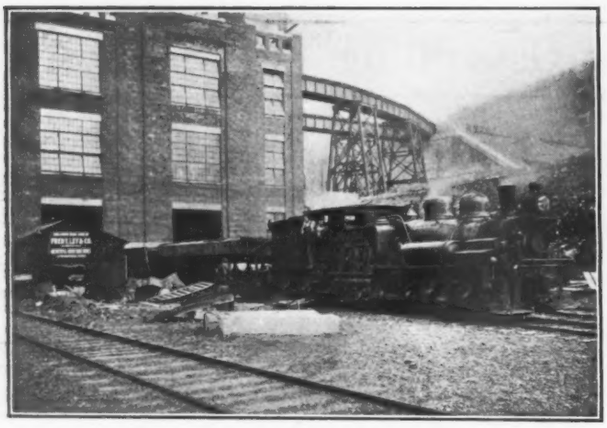


FIG. 2—ASH-HANDLING LOCOMOTIVE

FIG. 3—BOILER-ROOM FIRING AISLE

aisle, there being sufficient space provided to unload six cars on each track at the same time. The cars dump the fuel into concrete bunkers where a supply sufficient to operate the plant two days can be stored. Larger coal-storage facilities are not required as the mines, breakers and washeries are so close that there is never any danger of running short of fuel. Ashes are disposed of by running cars into the basement under the ash hoppers. The loaded cars are pulled out over an inclined track to the main line, by which they can be taken away and the ashes disposed of as desired.

Boilers

Satisfactory combustion of the low grade of coal employed requires use of very large grate areas and combustion chambers. Eight Babcock & Wilcox double-end units are installed at present, each of which is provided with four grates, half of each set being fired from one side and half from the other. The boilers are of the five-drum bent-tube type equipped with superheaters and designed for 225 lb. steam pressure. Exclusive of the superheaters, each boiler has 10,000 sq. ft. of heating surface. Six of the boilers are equipped with hand-fired dumping grates of special design, and the two remaining units are being equipped with automatic traveling grates which are a development of the Coxe design.

Design of Grate

In the case of the hand-fired furnaces the grates are 12 ft. deep and 8 ft. wide, making the total grate area per boiler 384 sq. ft. Four of the boilers are provided with Acme slotted-top grates and two are equipped with pin-hole tops. In each case about 6 per cent of the total grate area is occupied by air apertures, the holes or slots being about 3/32 in. wide. The apertures are at the bottom of grooves molded across the grate tops at right angles to each other, giving the appearance of a waffle-iron. The grooves are provided to prevent the coal from choking the apertures and thereby hindering a free circulation of air through the furnace.

One of the two furnaces which are being equipped with automatic stokers will have "piano-key" grate tops supported on the carrier bars, while the other furnace will be equipped with bars having pinhole apertures.

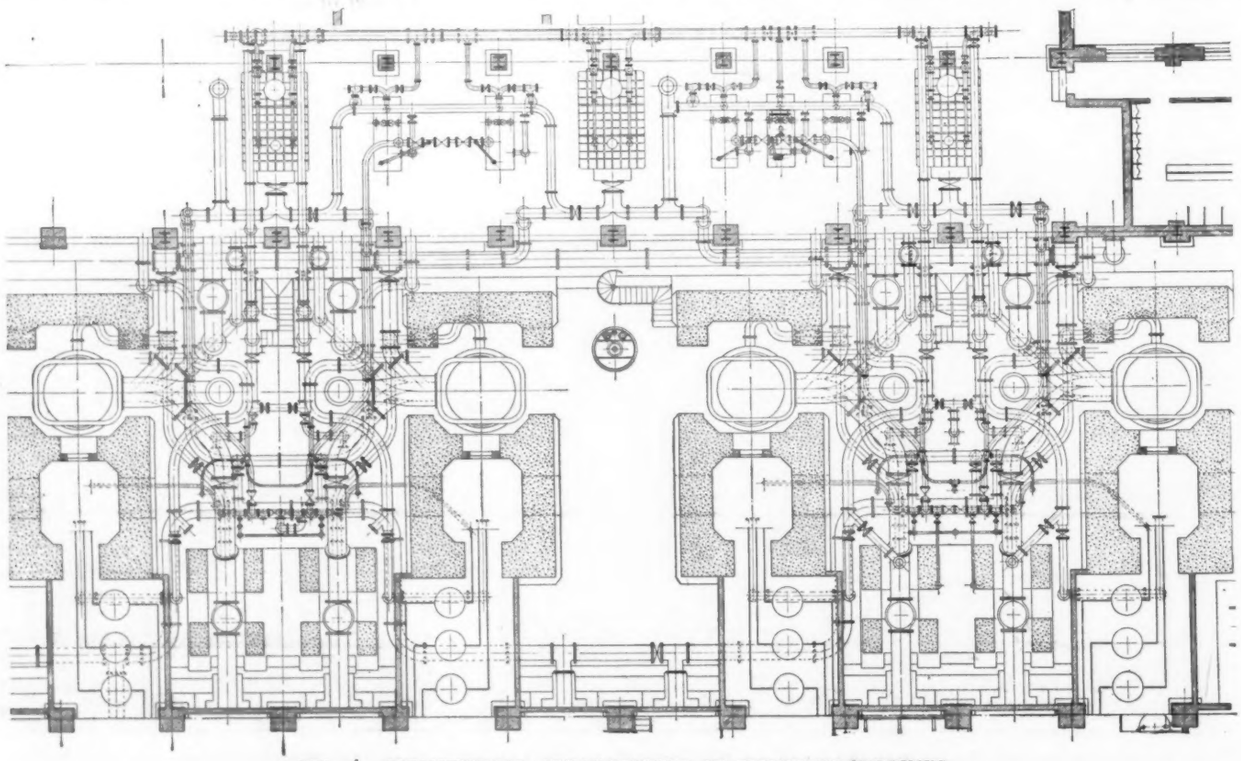


FIG. 4—SYMMETRICAL ARRANGEMENT OF PIPING TO TURBINES

The "piano-key" tops have projections on their adjoining edges which will allow air to enter the furnace between the bars. The bar type of automatic grate top, which is 6.5 in. wide and 8 in. long, has grooved tops similar to those employed in the hand-fired furnaces. Both types of automatic-stoker grate tops are arched to "bite" the fuel and thereby feed it into the furnace.

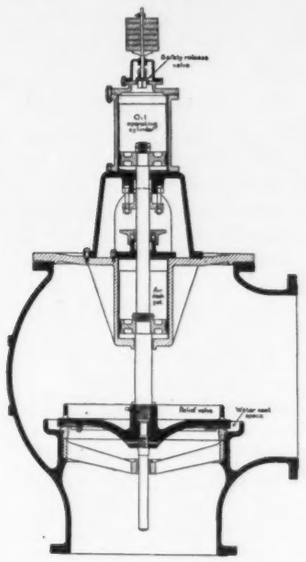


FIG. 5—SPECIAL ATMOSPHERIC RELIEF VALVE

Each top is fastened to its respective carrier bars by a T-slot joint and can be removed only by sliding it off the end of the carrier bar.

Provision for Expansion of Grate Tops

Lateral expansion of the "piano-key" tops is compensated for by expansion plates placed on each end of the carrier bars. These plates are supported on the carrier bars in the same manner as the tops, but inclined springs attached to the plates pulling from each side of the grate toward the center press the tops together laterally. One of the sprocket drums supporting each chain grate is supported so that it can move horizontally and at right angles to its axis, against the pressure of springs. When the tops change in temperature the expansion plates on the grate separate or approach each other to allow for expansion or contraction as the case may be; likewise the horizontal movement of the sprocket drum allows for longitudinal expansion of the tops.

The plate type of automatic stoker top is fastened at its center to the carrier bar so that it expands in all directions, but cannot creep along the bar; therefore no expansion plates are required on the grates so equipped. Horizontal movement of the sprocket drum is also provided as described above. Both types of traveling grate tops overlap each other in the direction of their travel so as to allow for clearance in passing around the drum and still not offer an opening through which coal can sift into the ash pit. As more air is likely to leak through the overlapping clearance than at other points in the grate top, the arched-top design serves another purpose, that of maintaining a thicker bed of coal over high leakage points than at others.

Other Features of Boiler Equipment

Other features of the furnaces are the use of vertically sliding furnace doors, recessed ash-pit doors and shaker handles to prevent obstruction to the firing aisles, double fire arches, cinder catchers, ventilation of fire wall to prevent burn-outs, and independent brick settings which are not affected by expansion of the metal parts.

Sliding doors were preferred to swinging furnace doors, as the latter are usually faced with firebrick, which attains a very high temperature and therefore becomes objectionable to firemen when the door is opened. The doors employed are counterweighted and are operated by pulling on a vertical rod hanging over the firing aisle in front of the furnace door. Double superposed fire arches are provided so that if the lower one burns out the upper one will come into use. Between the superposed arches is an air space through which air is allowed to circulate slowly in order to prevent the firebrick temperature from reaching such a value that the material deteriorates. The space over the grates is practically a reverberatory furnace, which insures the complete combustion of the fuel even if the draft does lift it off the grates as soon as a fresh charge is thrown into the furnace. The fire arch is 9.5 ft. long and covers over two-thirds of the grate area.

The combustion chamber above the bridge wall is

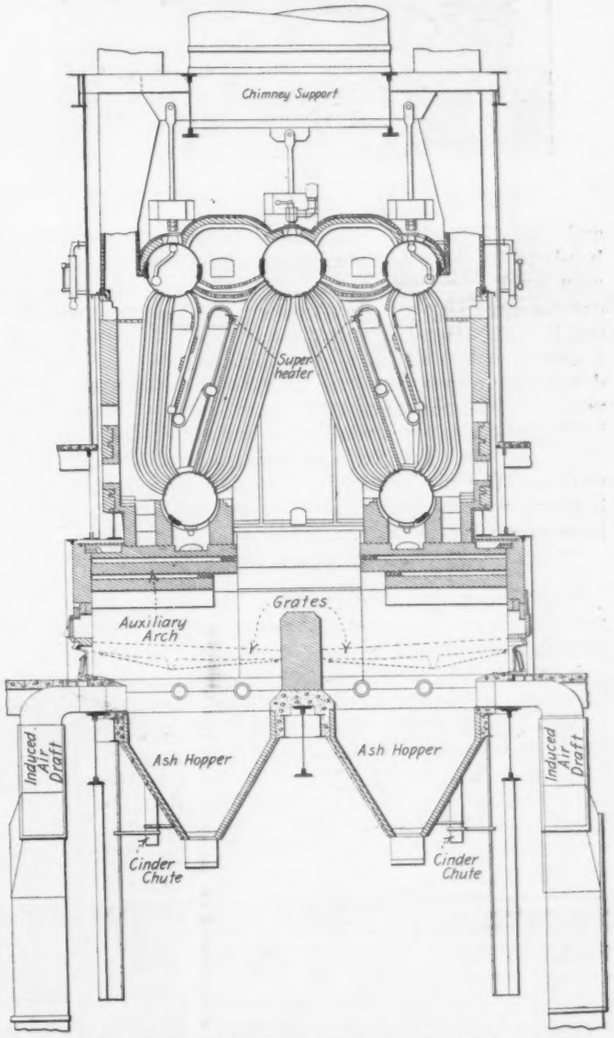


FIG. 6—DOUBLE-END BOILERS FOR BURNING CULM

unusually large and is so designed as to reduce the velocity of the gases and allow any unburned fuel to drop back into the fire and be consumed. The gases from four furnaces under each boiler pass up through the central combustion chamber and then divide at the top, going through two passes, striking the flues and superheaters (of which there are two to each boiler),

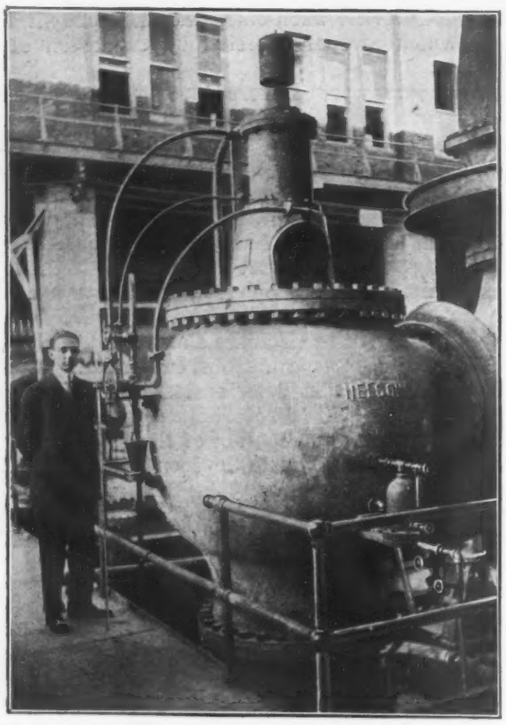


FIG. 7—ATMOSPHERIC-RELIEF VALVE FOR 12,500-KW UNIT

and then following the vertical uptakes at the boiler heads to the roof of the station, where they join a common stack. Whatever unburned fuel or cinder may be carried over into the first pass of the boilers is thrown out by centrifugal force at the bottom of the pass into a cinder catcher. This receptacle is provided with a down-take communicating with the ash-disposal basement. These chutes are normally sealed at the bottom by spigot-type valves which prevent air leaking into the flue space and thereby decreasing the draft over the grates. The cinder catchers consist of inverted steel hoppers which prevent any accumulation of material because of the absence of pockets.

Connection of Uptakes and Stacks

By joining the uptakes with the stacks above the roof of the building several advantages have been obtained, chief among which are the aforementioned saving in building cost and provision for future economizer installation. In addition, a shorter stack could be used and supported on the roof trusses, and facilities are provided for collecting the stack cinders at the bottom of the chimney and conveying them by gravity to cars in the basement.

Steam Headers

The absence of valves in the boiler headers is one of the features of the piping installation. Each set of four boilers is provided with its own open-loop header, which is independent of the headers carrying steam from other groups of boilers. Each loop passes down the firing aisle on one side of the boiler through a valve and thence returns along the other aisle, the two ends being connected in a pipe gallery to separate main headers.

The manner in which the boilers are connected to the boiler headers is also of interest. Separate pipes lead from the two outer upper drums of each boiler to separate superheaters whose outlets connect with a ball check valve supported on a pedestal beside the boiler. From the top of the valve the steam passes through a vertical pipe and another check valve into a horizontal pipe having valves on each side of the juncture. The ends of this pipe connect with opposite sides of the boiler-header loop so that steam may be fed into one or both sides of the loop. The feed-water piping is arranged similarly.

Main-Head Gallery

To provide support and convenient access to the main headers and at the same time lessen the danger to station attendants in case one of the pipes develops a fault while under pressure the main headers are installed in a pipe gallery. Duplicate headers run the entire length of this space, but each is divided into sections about the length of a boiler. Adjacent sections of the same header are joined by wide radius loops to allow for expansion. Each section may be directly supplied with steam from either of two sets of four boilers or from both.

All steam pipes are drained of condensation. In the high-pressure system both the "Holly-drip" and the "open-blow" system are employed. The "open-blow" discharges into the exhaust main passing through the feed-water heaters. The low-pressure system drains into sump pits which are emptied automatically by motor-driven pumps discharging into three tanks on the roof of the boiler house. This water is used exclusively for sprinkling ashes.

Forced-Draft Equipment

Installed at one end of the boiler room next to the pipe gallery are three motor-driven Sirocco blowers which furnish air for the furnaces. The fans take air from a vertical air shaft and discharge into a duct connecting with two tapering concrete tunnels running the length of the ash room under each firing aisle. Risers inclined in the direction of the motion of the air in these tunnels connect them with the air space under each furnace. Except in the case of the furnaces nearest the blowers (where four furnaces are fed from one riser) each riser supplies air to two furnaces. The draft in the furnaces is controlled by valves in the risers. The tunnels are cross-connected at the end nearest the blowers so that any one of the blowers may

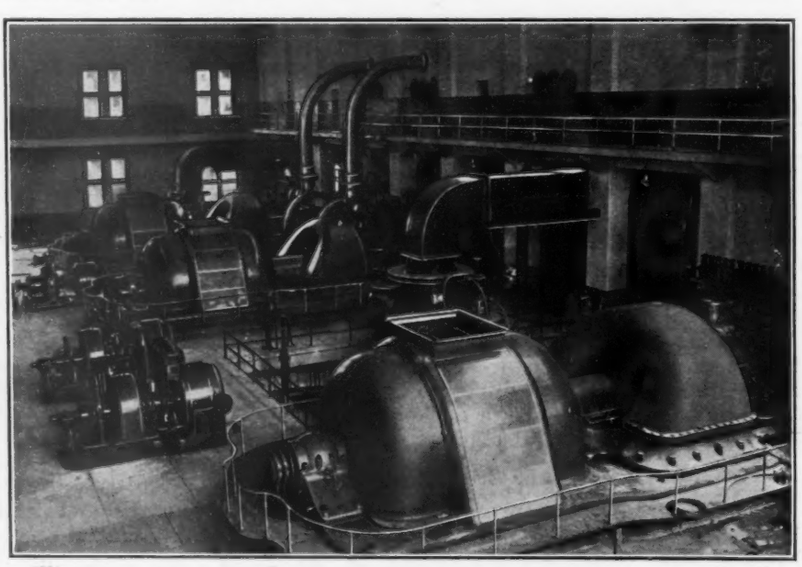


FIG. 8—MAIN ENGINE ROOM

be used to supply air to both tunnels. Sufficient air can be supplied by two of the blowers to operate eight boilers carrying full load. The third blower is installed as reserve equipment. The suction side of the fans may take air either from outdoors, from the top of the boiler room, from the pipe gallery or from the engine room. This flexible arrangement of the air intake permits of ventilating any of the heated portions of the building in the summer and also prevents the chilling of the building during the winter, by drawing air directly from outdoors.

Engine Room

Installed in the engine room now are three 12,500-kw, 11,000-volt, twenty-five-cycle turbo-generators the piping for which is laid out so that when more units are added it will be symmetrical about a center line between each pair of generators. This arrangement will facilitate following the connections to each unit when the plant becomes more complex, for if the connections to one turbine are known the others are also.

The method of connecting the turbine headers onto the main header is rather novel. Tapped into the lowest side of each main header is a short vertical pipe which connects with the middle point of a "bottle" consisting of a relatively short horizontal drum. Two turbine headers connect with the upper side of the drum at each end and extend through the pipe-gallery wall to connect with the turbine casing in a long radius bend. The ends of the "bottle" connect with pipes leading to auxiliary headers. The boiler, turbine and auxiliary header valves are placed in their respective pipes in the pipe gallery, but the valve stems extend through the pipe-gallery wall into the engine room, where they can be operated by the engine-room attendant.

Turbine Characteristics

The blading of the turbines is a modification of that used in the Rateau machine as developed by the Allgemeine Elektricitäts Gesellschaft, while the governing parts, impulse nozzles and their wheels are essentially the same as those employed in the Curtis turbine. When operating at full load and maximum efficiency these units consume 12.3 lb. of steam per kw-hr. with a vacuum of 28 in.

Condensing-Water Supply

To obtain water in sufficient quantity for condensing and boiler-feed purposes is a problem of no small import in anthracite-coal regions, as it is practically impossible to obtain water by sinking wells and streams are usually scarce and of such size as to give inadequate supply, or else are filled with acid and sulphur from the washeries.

Prior to the construction of the station large quantities of water were used in the coal washeries in this vicinity. The supply was obtained from mountain streams about 3 miles to the north of Hauto and was stored in a pond near the site of the present plant. The pond did not have sufficient capacity, however, to supply the combined needs of the washeries and the new plant, so a new dam was constructed giving a pondage of 269 acres and a capacity of 1,000,000,000 gal. The depth of the water in the reservoir is 25 ft.

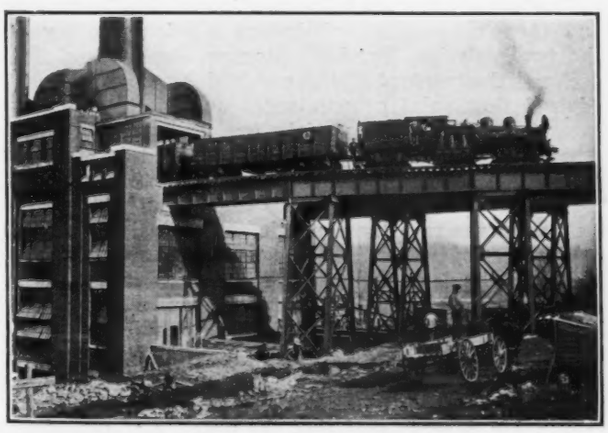


FIG. 9—COAL-DELIVERY TRESTLE

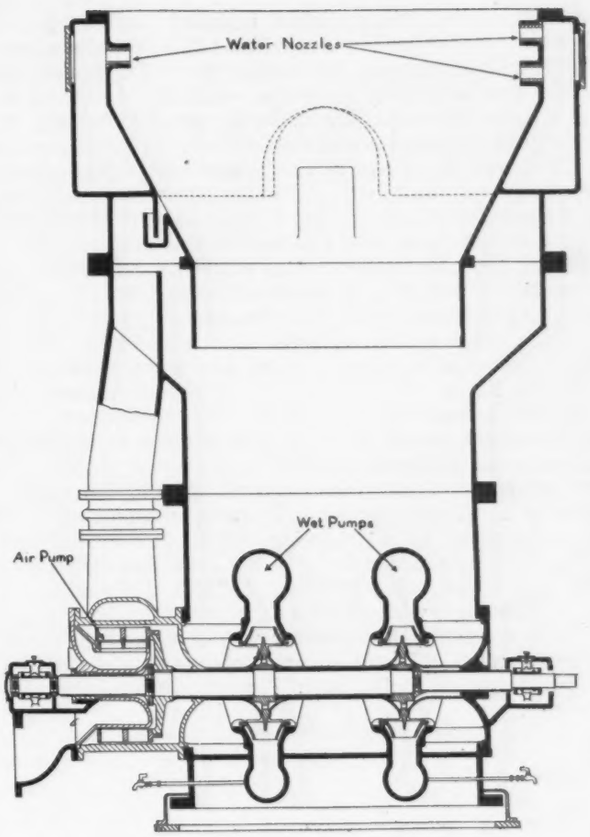


FIG. 10—12,500-KW JET CONDENSER

The dam is made of earth excavated for the most part from the site of the power plant. It is 1800 ft. long, 30 ft. high, 15 ft. wide at the crest, and slopes two to one on both sides. The upstream face is protected with concrete slabs, the joints being filled with bitumen. This facing is carried down over the front, thus forming a concrete cut-off wall that protects the mass of the dam from contact with the water.

No coal washeries are situated above the plant, so that the water is not contaminated or made unfit for boiler purposes. The general scheme for supplying water to the plant is to take water from a point about 2500 ft. above the dam, deliver it to the condensers and discharge the hot water into the pond again about 2100 ft. above the station, or about 4000 ft. above the intake. The water is thus used over and over again. The water in flowing back to the intake is cooled enough to meet the requirements of the service since a relatively large radiating surface is furnished in the discharge canal and in the pond.

Near the suction end of the intake tunnel is a headhouse in which are installed two steam-driven 70,000-gal. centrifugal emergency pumps which are employed to supply water to the intake tunnel when the pond level falls below normal. The pumps are equipped with hydraulically operated throttling valves which are partly closed when the load on the turbines is light. Unlike ordinary valves of this type, they can be maintained at any desired opening by properly setting

the remote-control switches installed in the power house. The intake tunnel, which is 13.5 ft. square, connects with another tunnel running parallel to the engine room but accessible from the exterior of the plant. From the latter duct 30-in. intake pipes about 112 ft. long lead to each turbine's condenser.

The condensers are of the Leblanc jet type and are the largest of their kind ever built. The wet-air and dry-air pumps, which are mounted on a common shaft driven by a turbine, are both inclosed in the exhaust casing leading from the turbine. The entire condenser unit is suspended from the lower side of the turbine. The condenser pumps are both of the centrifugal type, and the turbine driving them is rated at 445 brake hp. With the barometer reading 29.1 in. and when condensing 150,000 lb. of steam per hour these condensers will provide a vacuum of 28.1 in. The condensers are primed by allowing water to run into the rotating air pump until sufficient vacuum is obtained to lift the water from the pond into the condensers by barometric pressure. A priming tank is being constructed near the station which will be about 70 ft. in diameter and will discharge water by gravity into the condensers when they are being primed. A 24-in. main will connect this tank with the condensers.

Water from each condenser will flow through 30-in. pipes about 28 ft. long into a discharge tunnel running parallel to the engine room directly beneath the pipe gallery. At one end of the tunnel where it emerges from the building and joins the discharge canal is a weir having an adjustable crest which maintains a definite water level on the discharge side of the condensers and provides a water seal for the pipes emptying into the tunnel.

The canal is trapezoidal in cross-section and has earth and clay sides. It is 6 ft. deep, 18 ft. wide at the bottom, and the sides have a two to one slope. The water is discharged into the pond about 2100 ft. north of the plant or about 4000 ft. above the intake. As the power plant is enlarged and the generating equipment increased the length of the canal will be increased to allow the water to have more time in which to cool before it is drawn into the condensers again.

Special Atmospheric Relief Valves

Each pair of turbines is equipped with an atmospheric exhaust. Condensers of the size employed impose especially severe conditions upon the opening and closing of the atmospheric relief valves, so that they had to be designed with this in view. The valve used is provided with an air dash-pot in conjunction with the oil-operating cylinder. The oil-controlling cylinder has a dead-weighted piston on its upper side so that if the operating valve is left in the non-automatic position the piston will rise and allow the relief valve to open in case the vacuum fails. Another feature of this relief valve is the use of a Müller float valve for maintaining a constant level in the water seal and preventing any water running over and being wasted.

Two open feed-water heaters are installed, each one being capable of taking care of eight boilers. Three turbine-driven pumps draw water from these heaters and discharge into the boiler-feed headers, which are laid out on the same scheme as the steam headers and are controlled from the feed-water attendant's gallery. Each pump is rated at 450 gal. per minute.

The equipment of the Hauto power station is arranged on the unit system so that each turbine with its corresponding bank of boilers, together with each generator with its corresponding bank of transformers and outgoing feeders, may be operated independently as a unit. This unit system is carried out almost as completely in the control of the apparatus.

Papers and Discussions at the Session of the Iowa Section, N. E. L. A.

In the last issue of the *Electrical World* an account was published of the joint session of the Iowa State section of the National Electric Light Association and the newly formed Iowa Electrical Contractors' Association at Cedar Rapids on April 22 to April 24, and an extended account of the contractors' meeting was given. Below are abstracts of papers and addresses at the sessions of the State section, with notes on the discussions and other convention proceedings:

In opening the convention President A. L. Dodd, of Charles City, Ia., speaking of the events of the past year alluded to the death of George Westinghouse and cited many of his achievements. Attention was also called to the introduction of the nitrogen-filled tungsten lamp. Commenting on the outlook, Mr. Dodd said that in spite of the service rendered by the central stations in Iowa a few municipal lighting plants have been started. President Dodd advised owners of electric-service properties not to let an additional 1 per cent dividend blind them to the trend of public opinion. He also said that in his opinion the time is at hand when it is as uneconomical for small towns to operate electric plants as it is for a small manufacturer to operate an isolated plant. The speaker saw no reason why the entire State of Iowa should not be supplied with electrical energy from a station in the central coal district of the State. While business elsewhere had not been at its best, the load curves of the central stations throughout Iowa had all shown marked increases over the same months for last year, indicating that the sale and consumption of electrical energy were not affected by general business conditions to any noticeable extent.

Society for Electrical Development—Its Aims and Purposes

A paper on the aims and purposes of the Society for Electrical Development, written by Mr. J. M. Wakeman, New York, was read by Mr. H. B. Maynard, Waterloo, Ia., outlining the plans which had been formulated to unify and mass sales effort for the benefit of the entire electrical industry. A brief outline of the national advertising campaign to be conducted through newspapers, technical and trade journals, and through the Jovian Order and other similar societies, was given, showing how the general public, and more especially architects and builders, were to be interested in making electrical applications wherever possible. It was urged that the society should receive the moral support of enthusiasm, which is as necessary as financial aid.

Joint Meeting with the Contractors

Reading a paper on "Co-operation of the Contractor and the Central Station" before a joint meeting of the two societies, Mr. J. T. Marron, Rock Island, Ill., declared that central stations should do no wiring and advised that sales of appliances and electrical apparatus be made by the stations at fair prices. On the other hand, the electrical contractor should devote himself to the work for which he is best fitted, broadening out as he is able, for the bigger and broader the contractor the more he can help the central station.

Where co-operation is lacking, said the speaker, it is generally the fault of the contractor. He should know the manager of the electric-service company and solicit his aid. In Rock Island the contractors and the electric-service company have formed a plan for co-operative advertising, taking a large space in the local newspapers twenty-seven times a year. Referring to the jobber, Mr. Marron said that the practice of extending credit to unreliable wiremen and others made the job-

ber appear to the legitimate contractor as an incubator for curbstone contractors.

In discussing the paper, Mr. A. L. Dodd, Charles City, stated that in his city the central station did wiring but the contractor was really on the company's payroll, receiving 10 cents for each outlet he wired.

The Compensation Law and Insurance

Considerable time in the afternoon session was given over to Mr. G. A. Wrightman, of Des Moines, who explained the Iowa workman's compensation law, which takes effect July 1. Mr. Wrightman, as secretary of the Iowa State Manufacturers' Association, offered the electrical men inexpensive insurance in a mutual company formed by the manufacturers.

A lengthy discussion followed the offer. Those taking part were Messrs. F. H. Bellamy of Knoxville, J. P. Ingle of Keokuk, A. D. Ayres of Keokuk, A. L. Dodd of Charles City, Thomas Ferris of Osage, and Rufus E. Lee of Clarinda.

Data on the Operation of Keokuk Station

In a paper entitled "A Few Features of the Operation of the New Keokuk Development," Mr. A. D. Ayres gave a general description of the equipment installed in the great hydroelectric station on the Mississippi. Since the system had been operated on a plan analogous to the common train-dispatching scheme, with operators repeating their orders, no mistakes have been made to impair the service. The fifteen units now in the station delivered 923,000 kw-hr. in the month of December, 1913.

The Utility and the Law

In the absence of Mr. A. C. Huey, Chicago, Mr. F. W. Stearns, general counsel for H. M. Byllesby & Company, read a paper entitled "The Conduct of Public Utilities Under Commission Supervision," presenting the subject from the lawyer's standpoint. In general, said the speaker, the state commissions have been patient with the operators of utilities and the latter have been making an honest effort to conduct their business as the commissions dictated. Although there has been much talk about commission regulation, very few utilities would elect to return to the former system of municipal regulation.

Even commissioners entering office with the avowed notion that utilities' rates were high have been frank enough to admit, after being in office for a time, that in many cases the rates were not high enough to cover adequately proper charges for interest and depreciation and give a reasonable return on the investment. Speaking on the subject of securities, Mr. Stearns brought out the fact that with utility securities passed on by commissions this class of stocks and bonds is lifted from the speculative to the investment class.

To induce utilities under commission regulation to economize in operation. Prof. A. H. Ford, Iowa City, suggested that a clause be inserted in state laws creating commissions saying that when once rates had been regulated no further revision shall be made till the earnings pass some minimum and maximum limits, such as, say, 5 per cent and 12 per cent.

A Trip to Iowa State College

Thursday afternoon a joint party composed of the members of the Iowa State Section of the National Electric Light Association and the Iowa Street and Interurban Railway Association visited Iowa City, where Prof. A. H. Ford, of Iowa State College, delivered a paper on "High-Tension Lightning Protection." After a series of demonstrations showing the action of different types of lightning arresters, Professor Ford said that in purchasing insulators for high-tension lines he should demand one which would flash over at a potential of 50 per cent below its puncture voltage. This, he said, would eliminate the necessity of long service interruptions while linemen hunted for a punctured insulator. The speaker also showed the action of arcing rings and arcing points in protecting insulators from flash-over strains.

Affiliation with the N. E. L. A.

Mr. E. W. Lloyd, Chicago, vice-president of the National Electric Light Association, addressed the convention on the subject "The Objects and Results of Affiliation," telling how the local sections were aided by the national organization. Referring to each of the divisions of the national body in turn, Mr. Lloyd showed how member companies could keep themselves informed and solve their own problems by seeing what others had done under similar circumstances. The annual income of the association is at present about $100,000, an inadequate sum to carry out the work at hand. In closing, the speaker intimated that a movement was on foot to subdivide the National Electric Light Association into sections each dealing with a particular branch of the industry.

Convention Resolves Against Old-Code Wire

Following a paper by Mr. J. E. Latta, of the Underwriters' Laboratories, it was moved that the use of old-code wire be discouraged and the use of none but standard wire and approved fittings be countenanced. The motion was passed unanimously.

Saturation Point in the Sale of Electricity

In a paper entitled "Is There a Saturation Point in the Sale of Electricity?" Mr. J. S. Forbes, Cedar Rapids, said that the manager of the small central station who thought his business had reached a condition even approximating saturation was sadly lacking in initiative. Mr. Forbes recommended that in all small towns the lighting company should have a new-business department, even though the manager of the property had to look after it himself. Speaking of old-house-wiring campaigns, Mr. Forbes stated that the best plan yet evolved in Cedar Rapids consisted of offering complete wiring and fixtures for a fixed sum of $21. The Iowa Railway & Light Company, Cedar Rapids, now has 90 per cent of the motor load available but does not despair of the other 10 per cent. For getting the rural business the Cedar Rapids company has been encouraging the formation of farmer companies to finance the building of 2300-volt lines which will in time be taken over by the central station in return for energy supplied. It is estimated that there should be six customers for each mile of line costing about $600. Bills of farmer lighting customers average about $1.25 a month, and if motors are also operated about $2.50 more is added. Mr. Forbes suggested that a committee draft a standard form of contract covering agreements between such farm customers and the Iowa central stations.

Mr. F. S. Dewey, Davenport, in discussing the paper said he thought the cost of line construction for the proper type of 2300-volt line would cost more nearly from $800 to $1,000. He also cited the practice of the Davenport company where a minimum bill of $4 is charged each farmer to encourage the use of motors and appliances.

Facts and Factors

Mr. Austin Burt, Waterloo, chairman of the committee on facts and factors, reported to the convention the data collected with the help of the engineering experiment station at Ames, and given elsewhere in this issue.

Application of Polyphase Currents to Radiotelegraphy

Description of high-frequency polyphase generator and outline of tests made during use in radio service. By Edward G. Gage

THE production of continuous oscillations in an antenna for transmitting radiant energy has long been a favorite problem for engineers, and several methods have been produced by which this could be accomplished. Almost without exception when applied to radiotelegraphy the object sought hitherto has been to lower the decrement of the transmitter. This has

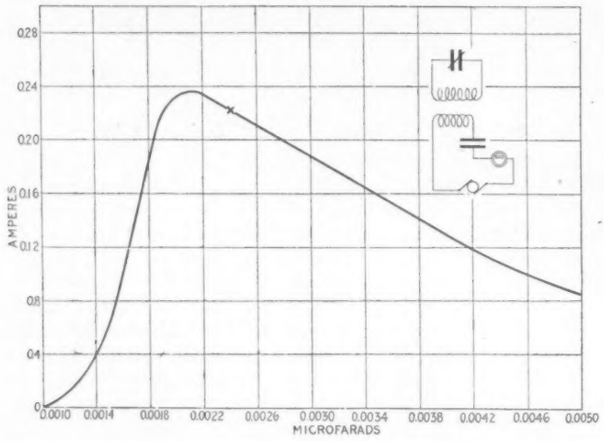


FIG. 1—RESONANCE CURVE OF 6000-CYCLE TRANSFORMER

given rise to the attendant practical advantages of probable small atmospheric absorption, sharp tuning, and incidentally the optional elimination of the rectifier or chemical detector from the receiving circuit. In dealing with continuous oscillations it is well to remember that for certain purposes it is necessary to have only practically continuous oscillations, the dividing line being the group frequency analogous to inaudibility in acoustics. The success of continuous oscillations is due not only to the fact that the transmitter emits undamped wave trains but in part to the additional fact that rectification of received signals by a "detector," with its attendant losses, is not required.

To determine to what extent polyphase currents might be utilized for wave production, the experiments described below were carried out upon a machine (shown in Fig. 4) designed for the work and presenting some unusual and possibly advantageous features.

In this polyphase alternator the armature and the field structures revolve in opposite directions, each being driven by a 1-hp series-wound motor directly connected to the shaft and capable of running at from 3000 to 3500 r.p.m. Alternating current can be taken from either of the revolving members. The armature is a laminated unit having laminations 0.02 in. in thickness. Fig. 5 represents various field and armature parts, all of which are interchangeable upon the same shaft. Even the windings are all easily removable, and they are interchangeable. This feature of flexibility has been embodied for laboratory purposes only, but any of the various combinations excepting one could be adopted as a fixed design. The machine can deliver alternating currents at 6000 cycles, either single-phase, two-phase or three-phase, arranged to deliver either 9000 cycles or 18,000 cycles single-phase current, though the power obtainable at 18,000 cycles is very small.

The arrangement with which this article has to do can hardly be considered a true three-phase system, as known in alternating-current practice, since the phases are individually connected to their separate transformers. It is simply three single-phase quenched-spark sets, each operating at 6000 cycles and so arranged that the discharges take place in regular rotation, producing a resultant of 36,000 sparks per second at maximum speed of the alternator.

Theoretically it appears that the best results would be obtained when the group frequency equaled the natural frequency of the antenna. This result can be obtained, but because the radiation resistance of normal antennas increases rapidly as the working wave-length becomes much larger than the fundamental, it is not always advisable to meet this condition. For example, in a case cited where the group frequency is 36,000 the most

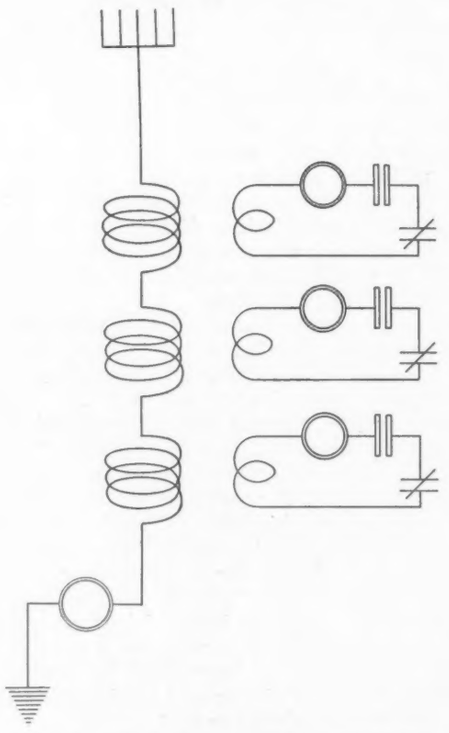


FIG. 2—OSCILLATING CIRCUIT DIAGRAM

efficient wave-length to employ would be that derived from the group frequency, i.e.:

$$\lambda = \frac{300{,}000{,}000}{N} = 8333 \text{ meters},$$

where λ = wave-length in meters and N = group frequency per second. To tune an average antenna to so long a wave would necessitate loading with inductance

to such an extent that its total resistance would no longer permit efficient radiation of energy.

Although the apparatus necessary for experiment may appear to be complicated, the system is in reality very simple, as the circuits of Fig. 2 show.

Before beginning experiments the first difficulty that came to mind was that of obtaining a clear note, and maintaining it on each phase so that the resultant would give silence in the receiving telephones. Since much trouble is experienced in 500-cycle outfits in keeping the note pure, it was only natural to expect the same difficulties here. As a matter of fact, however, the note was the least troublesome of any of the features, and it might be of interest to show how the problem was solved by the careful selection of proper transformer constants by trial.

Each transformer core comprises a bundle of silicon-steel strips bent into an open ring to allow for a leakage gap. The primary consists of a single layer of No. 20 wire wound for a few inches in the middle of the ring. The secondary is a coil of No. 24 double cotton-covered wire impregnated, having an inductance when free from iron of 65 millihenrys. The coupling between the primary and the secondary can be varied simply by sliding the secondary coil along the core or by tipping it at an angle.

It was found impossible to do without iron. With air-core transformers the solution is simpler, but al-

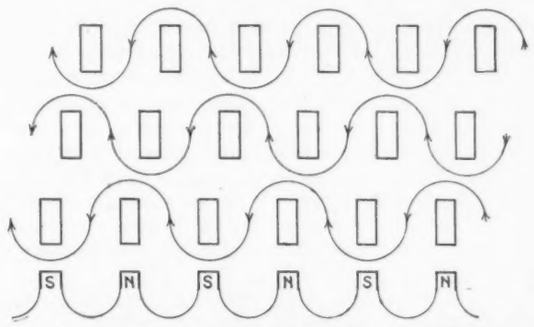


FIG. 3—ARRANGEMENT OF ARMATURE AND FIELD POLES

though at the available power and frequency of 6000 cycles very little iron is needed, the laminated core cannot be omitted. The final tuning of the transformer is obtained by means of variable condensers, even though according to a transposition of the usual formula

$$P = \frac{\frac{1}{2} CE^2 N}{10^6}$$

where C = secondary capacity, E = secondary voltage, N = primary frequency and P = primary power, this does not permit maximum efficiency. In this case it is advantageous to sacrifice over-all efficiency to regularity of operation, though the efficiency is kept reasonably high, nevertheless, by carefully proportioning the circuits to agree with the formula as nearly as possible.

Since low voltages are employed (about 4000 volts at the transformer secondary), ordinary rotary variable receiving condensers with oil dielectric can be used. By combining these with Leyden jars it is possible to adjust the secondary capacity as closely as may be desired. Fig. 1 shows the effect on primary 6000-cycle current obtained by varying the secondary capacity. The cross shows the most satisfactory value.

A quenched gap is used in each phase and consists of two copper plates with radiating flanges, paper gasket and parallel copper sparking surfaces. A pressure plate placed on top of each gap holds the units in position. A single gap is employed for each phase and is quite sufficient for the voltages present.

The inductance coils used in the oscillating circuits are made of "litzendraht" (stranded wire) wound on hard-rubber spools. Since the secondary inductance common to each phase when in operation consists of the three secondaries in series, it is found much bet-

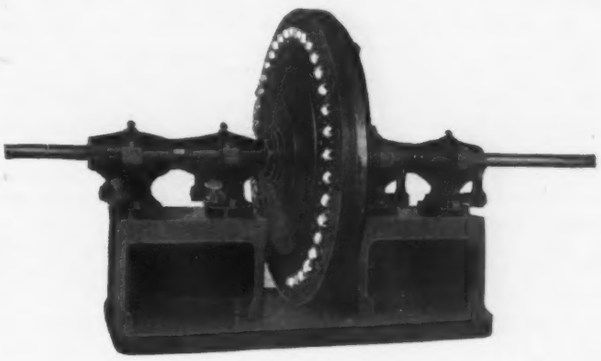


FIG. 4—6000-CYCLE, THREE-PHASE ALTERNATOR

ter to keep both primary and secondary windings fixed in self-inductance value and to allow for variation of coupling only. In the apparatus used each coil has an inductance of 100 microhenrys. This change can be obtained simply by placing the primary coil in various positions with regard to the secondary. Excellent flexibility in tuning is found possible by use of these simple arrangements since the variable condenser across the transformer secondary, the variable compensating capacity in the transformer primary circuit and the variable coupling afford entirely adequate means for preserving the regularity of note and radiation. Further adjustments are possible by varying the alternator-field strength (and hence the primary voltage) or by altering the value of reactance coils in primary or secondary circuits.

The compensating capacities (of 1.2 microfarad) used on the primary side are ordinary rolled-paper condensers placed in series, so arranged that any unit may be disconnected at will. The high frequency of

FIG. 5—ARMATURE AND FIELD PARTS

the alternator makes practicable this use of condensers directly in series in the primary circuit.

Hot-wire ammeters are placed in circuit with the power transformer primary, power transformer secondary, primary of oscillation transformer, and the antenna. The primary current at 40 volts no load (55 volts on resonant load) is 3.2 amp.

In the first tests of the apparatus, which were made in 1912 and 1913, an artificial antenna was used for very long wave-lengths. For working at higher wave frequencies a real antenna of 0.001 microfarad capacity and 4 ohms apparent resistance at the working wave-length, or 1050 meters, consisting of an inverted "L" 100 ft. in height and having a single vertical lead, was utilized.

At first great difficulty was encountered in the adjustment of all three phases to resonance at the same period, so that the resultant would be a single wave. A great deal of time was spent on this problem, and it was found that the electrical constants of each phase must be identical to accomplish the desired end. Not only must the oscillation constants be the same, but a uniform decrement must hold throughout, and no coupling can exist between separate phase circuits.

Imperfect balancing of one of the motors prevented the continuous use of 6000 cycles per phase, so that 4000 cycles was employed in most cases. This lower frequency was secured by running the field at reduced speed and produced a resultant of 24,000 groups per second.

Using a wave-meter calibrated to 15,000 meters maximum wave-length, with a rectifier as receiver, 8000 sparks per second on one phase produced an antenna current of 0.6 amp, with a clear, piercing note, there being no sign of partial discharges. Adding the second phase, the note corresponding to 16,000 sparks could be heard, but although each phase taken separately produced an apparently absolutely clear note, when they were run together a faint hissing entered into the tone given by the receiving telephone. Upon cutting in the third phase the antenna current increased to 1.5 amp, all sense of musical pitch became lost and the hissing slightly increased. It must be understood that this hissing sound was much smaller in amplitude than that of the musical tone. In fact the hiss was hardly distinguishable and could not be heard when the musical note was present. The reason for this is probably that an absolutely clear note was not obtained on each phase, and that the weak partials existing in it became prominent when the musical tone was increased in pitch to a point above the upper limit of audibility. The only fact to dispute this explanation is that partials usually have a definite wave-length, whereas the slight hissing could be heard throughout the range of the wave-meter. The effects were the same when a small antenna in another building was used for receiving, so that it is evident that the wave-meter was not excited by purely local disturbances.

It was found very difficult to measure the decrement of each phase accurately because of the close coupling of the wave-meter necessitated by the small power used. However, it seemed easy to obtain small decrements, and values greater than 0.1 per complete cycle did not appear unless circuits were purposely thrown far out of resonance. Decrements less than 0.04 per complete cycle per phase were not actually measured, but the results indicated that lower decrements were obtainable.

Interesting results were secured in the measurement of decrement of the resultant wave, with all three phases in operation. This quantity was evaluated both with and without interrupters in the antenna circuit, and identical results were had in both cases. It was found impossible to obtain for the resultant wave as small a decrement as that of any phase taken separately. The importance of this observation would seem to be that the value of polyphase currents used according to this method is not great for obtaining *undamped* oscillations. This conclusion refers only to cases where there are employed wave-lengths shorter than the value indicated as best by the group frequency of the resultant as outlined above. However, their extremely small decrement is not the only feature that makes continuous or practically continuous oscillations of marked value; if the decrement can be kept reasonably small (say 0.1 per period as in an actual case), there remain other advantages such as (1) comparatively low potentials in all circuits; (2) a constantly excited antenna circuit which is well adapted for the use of the sensitive heterodyne receiver; (3) flexibility, in that by use of an interrupter any audible note may be produced if it is desired to telegraph by the usual group frequency method; (4) sufficiently persistent excitation to permit wireless telephony, and (5) the possible use of the tikker receiver.

In the experiments the continuous or practically continuous oscillations were broken up into audible groups by means of a small commutator driven by a motor and connected in series with the transmitter primary or either the sending or receiving antenna. A machine with a disk cut so as to produce the letter "D" in Morse when driven by a small motor was also used for this purpose. The revolving interrupter was found convenient, since the same apparatus could be used at either the sending or the receiving end for breaking up the oscillations into definite groups. When an ordinary vibrating contact tikker is used there is no such positive action.

No special long-distance tests were made, but single-phase signals of 8000 group frequency were heard by several stations over 15 miles away and were reported as very clear and readable. The same stations (which used rectifying detectors) were unable to hear the 16,000 or 24,000 group frequency unless an interrupter was inserted in the antenna circuit. Both these latter group frequencies were heard very loudly when received by a small testing station located on the same grounds as the transmitting station and employing a tikker.

It was found that placing an interrupter in the transmitting antenna circuit to produce audible groups of waves gives no advantage in so far as loudness of signals is concerned. The apparatus used did not seem to produce an entirely clear musical note, perhaps because in this instance accumulations of oxide in the rotating commutator interfered with its regular action. In sustained wave practice there would seem to be no reason for its use, since the tikker may be advantageously employed, and when it is desired to use rectifiers as receivers a better way to render the signals audible would be to operate at a lower group frequency by running each phase on a lower octave.

The fact that the single-phase quenched-spark system is now well understood and almost universally employed in modern apparatus is an argument in its favor where limitations of power do not handicap it. In high-powered sets the synchronous rotating-gap method is certainly sufficiently capable of extension to permit signaling over great distances. In both of these the audible high-group-frequency method introduced by Professor Fessenden, a pioneer in both damped and continuous wave transmission, seems at present to be the choice for commercial work and is used almost exclusively by the leading navies of the world.

To sum up, the results of the experiments described would tend to prove that the application of polyphase currents to radio practice is perfectly feasible. The polyphase principle has been largely employed by the writer during the last two years, but since the work has been mainly of an experimental nature it has not yet proved its superiority by wide commercial application.

A. I. E. E. Papers at the Washington Meeting

Solenoids, lightning protection for buildings, transmission-line surges, theory of the corona and milliampere series transformers the subjects discussed

As stated in the report printed last week of the meeting held at Washington, D. C., on April 24 and 25, under the joint auspices of the electrophysics committee of the American Institute of Electrical Engineers and the American Physical Society, five papers by members of the former association were read. Abstracts of these papers follow.

Solenoids

In the paper by Mr. Charles R. Underhill it was pointed out that Maxwell's law does not hold for the attraction between two halves of the plunger in an electromagnet if it has an air-gap between the cores. This was explained by the fact that the flux in the cores is to a large extent independent of the reluctance in the air-gap on account of the magnetic leakage from the inner end of either core back to the other end of the same core. An equation was deduced for computing the pull of an electromagnet of this type with a fixed stop. The author states that in any case the attraction that draws the plunger within the coil is proportional to the product of the average intensity of magnetization within the structure of the plunger and the average magnetizing force within the solenoid. The total pull in kilograms for a plunger electromagnet with or without an iron frame is

$$P = \left(\frac{\varphi_g^2}{247\,S} + \frac{\varphi_i inh}{1962\,L}\right)10^{-4}$$

where φ_g is the flux in the air-gap, S is the cross-sectional area in sq. cm, φ_i is the flux in the plunger, i is the current in amp, n is the number of turns in the solenoid, and h is the coefficient of magnetizing force which is proportional to the length L (in cm) and average radius of the solenoid.

Dr. C. W. Burrows suggested that some of the assumptions made by Mr. Underhill involved approximations that reduced the accuracy of the figures in the tables submitted. He also questioned the method of dividing into two parts the magnetomotive force, as utilized by the author in his discussion.

In a written communication Mr. E. R. Carichoff characterized the paper as a notable contribution to the subject and added comments on the formulas employed.

Lightning Protection for Buildings

The paper by Mr. L. A. DeBlois contained an account of some very extensive experiments to ascertain the effects of different methods of lightning protection on direct lightning strokes. It also described some of the dynamic and static inductive effects produced in a building in the vicinity of a direct lightning stroke. An analysis by oscillograph of the secondary currents induced by actual lightning discharges in vertical earthed conductors seems to indicate that such currents are non-oscillatory and aperiodic, though occurring in either the negative or positive direction. The phenomena generally attributed to high-frequency oscillations is explained by the existence of unidirectional waves of almost vertical wave fronts. Experiments were also conducted to observe the effect which cloud height, lightning-rod arrangement and building materials have on direct strokes between a cloud and an isolated building located directly beneath it on the earth.

As a result of the experiments it was recommended

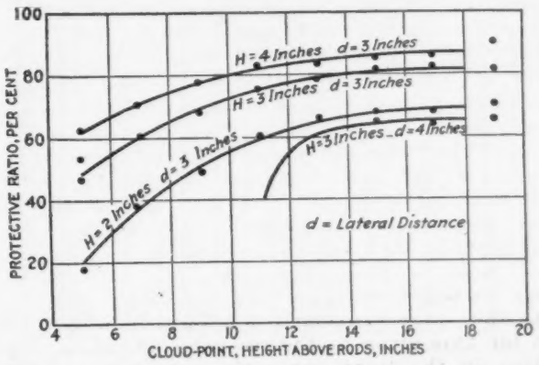

PROTECTIVE RATIO, PER CENT
CLOUD-POINT, HEIGHT ABOVE RODS, INCHES
H = 4 Inches d = 3 Inches
H = 3 Inches d = 3 Inches
H = 3 Inches d = 4 Inches
H = 2 Inches d = 3 Inches
d = Lateral Distance

FIG. 1—EFFECT OF CLOUD HEIGHT ON ROD EFFICIENCY

that the following practice be observed in protecting buildings against lightning:

A series of vertical isolated rods of iron pipe should be placed outside and surrounding the buildings and grounded to annular conductors buried in the earth at least as low as the water pipes, with extensions running out radially at the corners; metallic roof projections such as ventilators should be eliminated as far as possible; metallic roof and floor coverings should be grounded at their salient angles; overhead pipe lines and other metal conductors should be grounded at intervals

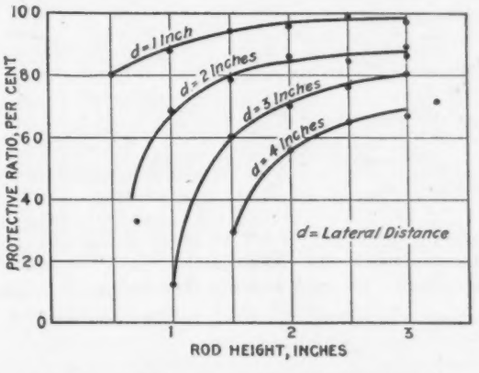


FIG. 2—EFFECT OF HEIGHT AND SPACING

and also where crossing the annular conductor; lightning arresters should be provided for outside electric lines and also for the lowest points of the building wiring (to remove static charges), and all metal objects in the interior of a building should be interconnected and grounded.

In opening the discussion on Mr. DeBlois' paper Mr.

E. E. F. Creighton commented on the small amount of study hitherto accorded the subject of direct lightning strokes. The natural frequency of lightning is still, he said, rather questionable, but observations have certainly shown in some cases the presence of high frequencies. In such strokes part of the discharge at least was proved to have been oscillatory.

Mr. G. R. Olshausen exhibited some interesting pictures taken with a rotating camera. One of these clearly showed an initial slight discharge followed almost instantly by a heavy flash. After a perceptible interval there was then another flash tapering off into a bandlike continuous discharge, and this in turn was followed by several heavy flashes which were accompanied by closely laminated smaller discharges suggesting very strongly an oscillatory character. Cases where lightning discharges have magnetized iron objects show clearly, said Mr. Olshausen, that these flashes at least were unidirectional.

Dr. A. G. Webster emphasized the point that in advance of a lightning flash there is always an initial discharge which ionizes and heats the air, preparing the way for the main flash. He also suggested that such a heated air path may have a comparatively low resistance.

Dr. Elihu Thomson mentioned having heard telegraph sounders and telephone bells click during thunderstorms, and declared that these impulses must have been caused by direct-current discharges since high frequencies could never have traversed the coils of the apparatus. At the beginning of a lightning discharge, he said, "feeder" lines are often seen—branching in all directions over the cloud surface and thus discharging great areas into the central direct flash. As viewed in perspective such feeders sometimes appear as branches, although a little reflection will reveal their true relation as tributaries to the main lightning stroke. In answering a questioner who had asked for an explanation of the frequent destruction of barns by lightning, as compared with other buildings, it was pointed out that the ammonia salts present in the earth beneath a barn invariably make it the best "ground" to be had. Lightning-rod constructors should accordingly take the hint and ground their conductors within the saturated area of the barn rather than a few feet outside as is the common practice.

Dr. W. J. Humphreys said that many flashes show branch paths near angles, although these invariably recur in both the same position and direction in successive discharges, thus affording testimony that these main discharges were all in the same direction rather than of an oscillatory nature.

Mr. T. D. Yensen submitted a written discussion confirming the results of Mr. DeBlois' experiments.

In the absence of the author Mr. Burton McCullom next abstracted in brief Professor Franklin's paper on transmission-line surges. He also cited an instance where a lightning discharge had entered a station and reversed the polarity of the fields of the machines.

Some Simple Examples of Transmission-Line Surges

The paper by Prof. W. S. Franklin treats of the true wave phenomena which take place in transmission lines when switches are opened or closed. The phenomena are practically the same in alternating-current and direct-current circuits for transmission lines up to, say, 150 or 200 miles long. The "ribbon wave" was employed to represent line surges graphically. When a wave is reflected from the open end of a line either the voltage, or the current, or both, will be reversed. The total voltage at the end of the line may have any value, but the total current must be zero. If the voltage is reversed, an excessive potential will be produced when the reflected and original waves overlap. Consequently a cable capable of withstanding only 2000 volts should be protected by a spark-gap arrester which will break down at 1000 volts. If a line is short-circuited at the opposite end from the energizing source, the reflected wave will have the same voltage and current as the original, but one will be reversed. The total current at

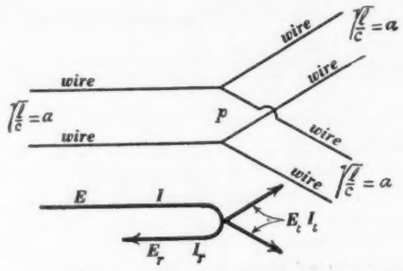


FIG. 3—WAVE PARTLY REFLECTED AT A POINT WHERE AN AIR LINE CONNECTS WITH AN UNDERGROUND CABLE

the end of the line may be any value, but the total voltage must be zero.

When a non-inductive resistance is connected across a line the reflected voltage and current must bear the same ratio as in the original wave except for reversal of sign. If the value of the resistance is equal to the original $E \div I$, there is no reflected wave; if greater than this ratio, there is partial reflection with reversal of current, and if smaller than $E \div I$, there is partial reflection with reversal of voltage.

If an inductive receiving circuit is shunted across a line, there will be a complete wave reflection with reversal of current the instant the ribbon wave strikes the inductance. A current is slowly established through the receiving circuit, however, and the reflected wave grows weaker, passes through zero and builds up in the opposite direction with reversal of voltage.

A method was described for plotting a curve to show the potential at any point in a line at any time after a generator has been connected thereto. The wave is reflected from the distant end of the line with reversal of current or voltage, depending on whether the line is closed or open.

Examples were also given showing how to determine the reflected and transmitted waves which occur when an aerial and underground line are connected in series and when a transmission line is connected to branch circuits. When a circuit-breaker opens, the arc usually persists for a long time, relatively speaking, but the open gap, which is a fairly good conductor, gradually

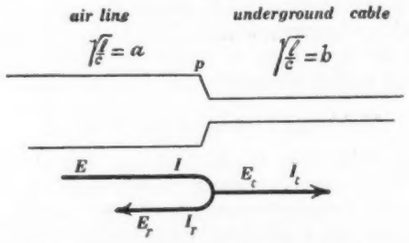


FIG. 4—WAVE PARTLY REFLECTED AT A BRANCH POINT OF AN AIR LINE

loses its conductivity. Therefore, it is nearly impossible to produce a characteristic line surge by opening a circuit in this manner. The formation of a long arc between line wires in air, and the rapid extinction thereof, is the only way, in the author's knowledge, of producing a wave disturbance from opening a transmission-line circuit of moderate length.

Mr. J. M. Weed declared that while the steepest wave fronts are caused by the direct making or breaking of the circuit, by the time such waves have traveled any considerable distance they will be quite tapered.

Dr. A. G. Webster next presented some sound analogies to explain electrical surges and described an

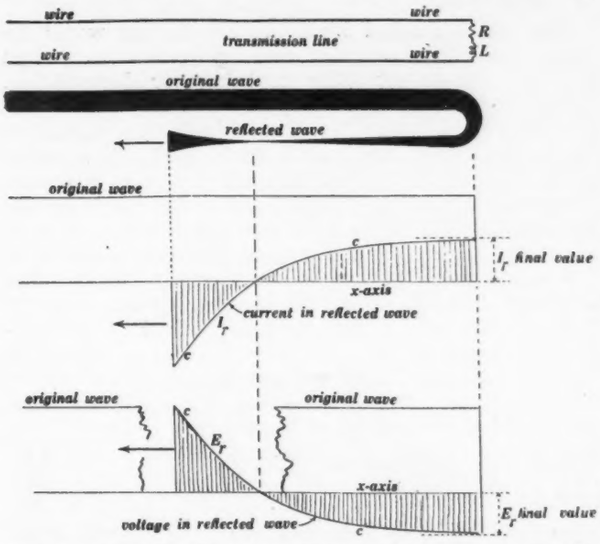


FIG. 5—REFLECTION OF A RIBBON WAVE FROM A RECEIVING CIRCUIT OF RESISTANCE R AND INDUCTANCE L, WHEN $R = \frac{1}{3}\ a$

experimental method for observing the propagation of a charge along a wire.

Theory of the Corona

A theory of the causes and factors governing corona discharge was developed in the paper by Mr. Bergen Davis, the hypothesis being based on the known laws of electrical discharge through gases and the assumption that ionic density is increased by ionic impact when the potential gradient is high enough. The manner in which the ionization builds up around a conductor subjected to a high potential is shown graphically by the

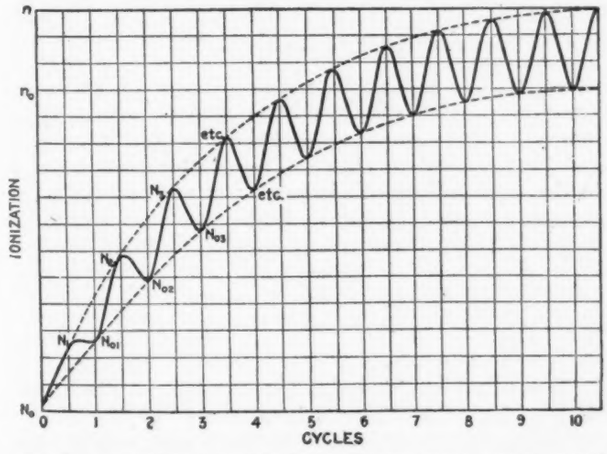


FIG. 6—INCREASE OF IONIC CONCENTRATION WHEN CONDUCTOR IS ENERGIZED

accompanying curve. After a number of cycles the density of ionization at the surface of the conductor assumes a constant value and if it is high enough corona discharge will occur. Equations which were developed from theory and plotted to indicate when corona would appear agreed remarkably well with similar curves obtained by experiment.

The paper pointed out that the real dielectric strength of air is not altered by the curvature of a conductor in contact with it, but the apparent dielectric strength is. Above the potential which is required to produce a corona discharge the rate of energy loss into the surrounding medium increases very rapidly. To produce corona around a conductor surrounded by a metallic cylinder requires a considerably higher surface potential gradient than when the wire is supported in the open. When high-potential conductors are hung parallel to each other in the open and brought near together without causing a flashover the surface gradient becomes nearly as great as for wires surrounded with cylinders. As an illustration—when two conductors of 0.1 cm radius are supported 20 cm apart the gradient is 58,000 volts per cm, while if they are 7 cm apart the gradient is increased to 61,000 volts per cm.

Milliampere Series Transformer

The construction and characteristics of a 100-to-1 milliampere series transformer for studying the charging currents of single high-tension insulators was described in the paper by Mr. Edward Bennett. A vector diagram was shown indicating the phase relations of current, voltage and magnetic flux in this device when delivering 0.05 amp (one-half of its rated out-

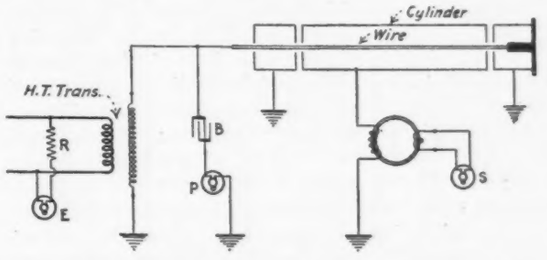


FIG. 7—CONNECTION FOR STUDYING CURRENT DURING CORONA DISCHARGE

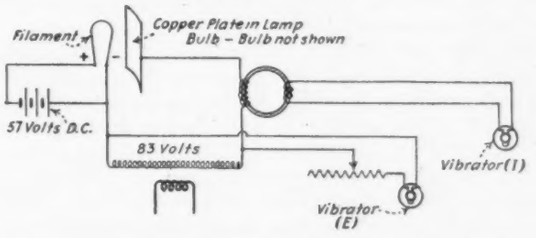


FIG. 8—CONNECTION OF MILLIAMPERE CURRENT TRANSFORMER FOR STUDYING LEAKAGE IN LAMP BULBS

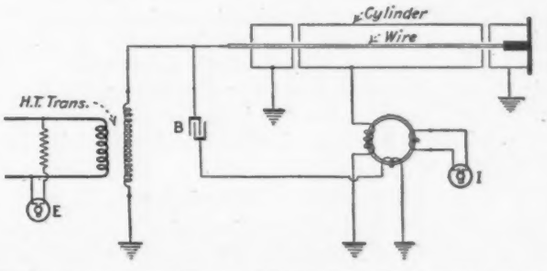


FIG. 9—CONNECTIONS TO SHOW REPRODUCTIONS OF HARMONICS

put) to the secondary circuit. Methods of obtaining the transformer constants at normal and high frequencies were outlined and a number of applications of the device to the study of corona, high-tension insulators and leakage currents in evacuated lamps were suggested. Several oscillograph curves obtained with the help of the transformer were included in the paper.

Hearing of Missouri Commission on Accounts

The hearing before the Missouri Public Service Commission on April 15 in regard to the tentative system of accounts has been mentioned briefly in the *Electrical World*. A more extended account of the proceedings is published herewith.

Utility Men Report on Depreciation

After the preliminary announcements by Mr. Atkinson, the first procedure in the businesslike hearing of April 15 was the presentation by Chairman Philip J. Kealy, of the Kansas City Railway & Light Company, of the report on depreciation adopted by the Missouri Electric, Gas, Street Railway & Water Works Association. Two principal subjects were considered by the committee—first, the deduction of reserve for depreciation from fixed capital as provided in Schedule No. 7 of the tentative draft of the annual-report form for electrical corporations; second, the seeming intention of the commission to consider the depreciation reserve as a fund and to require interest to be set aside on this fund. In relation to the first subject the committee recommended that the commission be petitioned to consider the depreciation charge as reserve account, unless, in the judgment of the commission in individual cases, it should be otherwise ordered.

In relation to considering the depreciation reserve as a fund, the committee judged it to be the intention of the commission to require the depreciation reserve to be invested in securities of immediate market value. While this method may have theoretical advantages, the committee pointed out two objections: First, the plan will tend to increase the cost of service to the ratepayer; second, the method, in so far as the financial condition of a large number of companies in Missouri is concerned, is impossible of fulfilment. In very many cases it is absolutely essential, if the wants of a growing community are to be served, that the depreciation reserve be invested in new plant. Mr. Kealy's committee cited the case of the Kansas City Electric Light Company to prove this.

In equity it is right to allow interest on the depreciation fund or depreciation reserve. Where the financial returns of a company permit a sufficient amount to be set aside annually to provide for depreciation, it is immaterial to the company whether this total amount be considered solely as principal or as principal and interest. The point of the matter here is that each company should set aside a determined sum of money, and the amount, not the source of it, is the important consideration. The particular circumstances surrounding the management of each individual company should be considered before a decision is made in this matter of interest on the fund. In addition to Mr. Kealy, the report was signed by Messrs. C. E. Brenton, St. Louis, Union Electric Light & Power Company; Charles E. Foster, St. Joseph Railway, Light, Heat & Power Company, and R. C. Russum, Joplin, Empire District Electric Company.

Discussion on Depreciation

There was an interesting discussion on the important subject of depreciation. At the outset the atmosphere was cleared considerably by the statement of Mr. McShane that the commission does not intend to reduce capitalization by the amount set aside for depreciation. This amount should not be written off. As to depreciation considered as a fund, Mr. McShane remarked that this is required by the public service law. The speaker did not see any real objection to the use of this fund for plant extension. Mr. Kealy said there was no objection to paying interest on the depreciation reserve. If it is required that there be an actual fund of marketable securities, this will increase the cost of service. Mr. McShane thought that a company might be permitted to borrow from its own depreciation fund, replacing the amount taken by betterment notes bearing interest, say, at 4 per cent. This would keep the fund intact and at the same time meet the requirements of the companies.

Mr. Russum asked what the commission would require if a utility company really did not have enough net earnings to set aside anything for depreciation. Mr. McShane answered that every company should provide for depreciation. Mr. Hugo Wurdack, of the Light & Development Company, St. Louis, said that the condition mentioned by Mr. Russum is a very real one. He thinks the public is interested in service first. By the introduction of an adequate and scientific system of accounting many of the small utilities of the State would find that they are not making any money. The company should be required to keep its plant up to 100 per cent efficiency, and perhaps that will do. The commission should have an option in the matter of requiring the setting aside of a depreciation fund.

Mr. J. N. Chester, of the Jefferson City Water Company, said that every plant should earn a depreciation reserve every year. If necessary, the rates should be raised to permit this. There should be no such thing as deferred maintenance. Mr. Stanley Young, Kansas City, of Arthur Young & Company, and president of the Missouri Society of Accountants, pointed out the necessity of providing for obsolescence and inadequacy, even if the plant is kept at 100 per cent efficiency. If depreciation in this sense is not provided for, the company is operating at a loss even if the books do not show it. The speaker did not approve of the funding of depreciation. But depreciation reserve may be reinvested in new plant. Mr. Young warned his hearers, however, that it is dangerous not to set aside a depreciation reserve. Depreciation is a part of the cost of operation. Mr. Kealy remarked that the whole idea of a depreciation fund is to equalize maintenance. It is necessary at all times to keep the fund there for the protection of the property. However, this "fund" is never to be distributed, and it is to be remembered that amortization is altogether different from depreciation. If it is borne in mind that a public utility is always to be regarded as a going concern, it will be seen that the depreciation reserve, or so-called "fund," can never be distributed.

Mr. James B. Campbell, St. Louis, of Marwick, Mitchell, Peat & Company, chartered accountants, said that two factors must be considered—first maintenance and then depreciation. The depreciation fund belongs to the stockholders. It is proper to reinvest it in the property of the company. Betterment notes may be issued for this purpose. So far Mr. Campbell agreed with the preceding speakers, but here he made the rather unexpected statement that interest on these betterment notes should go into the surplus of the company. It is very difficult, he said, to tell what is depreciation and what is maintenance. In answer to a question, Mr. McShane said at this point that he did not think that the permission of the commission would be required to authorize a company to issue betterment notes allowing it to borrow money from its depreciation fund for replacements. This point was brought up because the law requires the commission to supervise the issuing by utility companies of notes which are sold to the public. Mr. I. R. Kelso, of St. Louis, a lawyer, declared that in any event the depreciation question rests in the discretion of the commission. Mr. J. C. Adams, of St. Joseph, a water-works man, also took part in the discussion. Mr. McShane pointed out that the blank schedules sent out require the companies to set aside a rea-

sonable depreciation, leaving it to the company to decide what the rate of depreciation should be. He also emphasized the point that in preparing these schedules and rules the commission had intended them to be of benefit to the companies as well as to the commission.

Mr. Chester said that an average rate for water-works depreciation would range from one-half of 1 per cent to 2 per cent. If one general flat rate of percentage for depreciation could be adopted in the case of each individual plant, it would simplify matters greatly. Mr. Chester laid considerable stress on this proposal. Mr. Kealy said that this suggestion could not be carried out very well by street-railway and electric-service companies. For these utilities the detailed schedule seems to be necessary. Mr. Wurdack saw no objection to figuring depreciation on a large number of items because the depreciation on the various items might change from year to year, and the commission would want to know why the rate of depreciation was changed (if it was changed) in the case of each individual concern.

Historical Data Required

Mr. Wurdack, of St. Louis, presented to the commission the report of the Missouri Electric, Gas, Street Railway and Water Works Association committee on the historical data requirements of the proposed classification of accounts.

Mr. James L. Harrop, chief engineer of the Public Service Commission, declared that the information in relation to the consumption of various classes of consumers is needed for rate-making purposes, and that it is asked by the commissions in both New York State and Wisconsin. Mr. Kealy remarked that there is only one company in the State that could fill out Schedule No. 75 properly, and he did not see how the smaller companies could hope to do so. Mr. Brenton, auditor of the Union Electric Light & Power Company, St. Louis, the company referred to, explained how the Hollerith card-classification machines were used by his company.

Classification of Accounts

Mr. Edwin Gruhl, of the Union Electric Light & Power Company, St. Louis, as chairman of a committee of the Missouri Electric, Gas, Street Railway and Water Works Association, read a report on the proposed classification of accounts, particularly as related to the smaller companies, but also as applied to the larger ones. Mr. Gruhl's committee, after comparing the proposed classification of accounts in Missouri with the classifications of other state commissions and those of the Interstate Commerce Commission, urged that considerable simplification be adopted in Missouri and that an effort be made to have the classification conform to that of other states. Further, Mr. Gruhl's committee urged that for purposes of classification the electric-service companies of the State be divided in three classes, one having gross annual incomes of $10,000 and less, one having incomes between $10,000 and $50,000, and a third having incomes of over $50,000. The last class probably would be able to comply with the classification of accounts substantially as proposed by the Public Service Commission, but a simpler classification should be provided for the other two classes. In the case of water-works there might be two classifications, one applying to companies having gross incomes of $25,000 a year or less and the other to companies having larger incomes. Mr. Gruhl took up the proposed schedules in considerable detail and analyzed them. Among other things he called attention to the fact that some items of utility-company expense were omitted. One of these is compensation for injuries and damages; another is public service commission expense, and there are some others. Mr. Gruhl remarked that the classification of the Missouri commission follows rather closely those of the New York and New Jersey commissions.

At the conclusion of this committee report Mr. McShane said that it is true that the tentative draft of uniform accounts sent out under general order No. 12 was not suitable for small companies. Indeed, it was not the intention of the commission to require the smaller companies to use these tentative forms. The idea was to reach an agreement with the utilities as to general principles and then adopt a simpler classification for the smaller companies. As to electric-service corporations, Mr. McShane thinks that two classifications ought to be enough, but possibly three are necessary.

As to Municipal Utilities

The chairman called on representatives of the municipal utilities to express their views on the proposed classification of accounts. Mr. McShane declared that he thought the municipalities need accounting systems more than private corporations do. If a proper cost system were installed by the municipalities, they would find out what the service really costs and could make corresponding charges. Furthermore, requiring both municipal and private companies to use the same report forms would make possible a fair comparison between municipally operated and privately operated utilities.

All Agree to the Appointment of a Conference Committee

At this point Mr. McShane suggested the appointment of a committee of utility men, particularly those connected with the great interstate syndicates having to do with state commissions in other states. He said he thought that his department would be able, after conferring with such a committee, to arrive at a common ground, and that the classification of accounts might be condensed and simplified for the smaller companies.

After the adjournment of the formal hearing, the utility men held a meeting at which Mr. Kealy presided, and members of the conference committee of twelve on classification of accounts were appointed as follows: Messrs. P. J. Kealy, Kansas City Railway & Light Company; Edwin Gruhl, St. Louis, Union Electric Light & Power Company (North American Company); Hugo Wurdack, St. Louis, Light & Development Company; F. B. Saunders, Lexington, Missouri Gas & Electric Service Company (Middle West Utilities Company); J. C. Adams, St. Joseph Water Company (American Water Works & Guarantee Company); R. C. Russum, Joplin, Empire District Electric Company (Doherty Operating Company); J. M. Scott, Kansas City Gas Company (United Gas Improvement Company); H. H. Gansloser, Springfield Gas & Electric Company (Federal Light & Traction Company); W. J. Achelpohl, Jefferson City Light, Heat & Power Company (Western Railways & Light Company); J. N. Chester, Jefferson City Water Company (American Water Works and Guarantee Company); representatives of the St. Louis water-works department and the Kansas City water-works department, to be named later.

Bond Discount

Mr. McShane said he thought that bond discounut ought not to be classed as a part of the cost of the plant. Mr. Chester pointed out that a water-works company, for instance, must pay more for money when money is high, just as it must pay more for iron pipe when pipe is high. In both cases it would seem that this added expense should be considered as part of the plant cost and charged to capital account.

Central Station Management

Devoted to Discussion of Administrative Policies, Commercial Methods and Current Practice Among Successful Utilities

A Household Appliance Campaign at Louisville

The Louisville (Ky.) Gas & Electric Company is pushing its campaign for the wiring of houses on the instalment plan and in connection with its advertising is calling attention to the numerous articles of household use which can be thus made available to the woman who has not had electricity in her home. Special attention has been paid in this advertising to the vacuum cleaner and to the great amount of labor that one of these appliances saves. On other days emphasis is placed on electric cooking utensils and the unusually good coffee which can be made quickly and easily in an electric percolator. The advantages of the electric fan will be urged during the summer.

Operation of Small Refrigerating Machines Using Electrical Energy

At the weekly luncheon of the Chicago Jovian League on April 27 the principal speaker was Mr. R. J. Stewart, manager of the insulation department of the Chicago office of the H. W. Johns-Manville Company. Mr. Stewart read a paper descriptive of the Audiffren-Singrun refrigerating machine, which is marketed in this country by the Johns-Manville Company and built under contract at the Fort Wayne works of the General Electric Company. These machines, used both to produce refrigeration and to make artificial ice, are well adapted for electric drive, and Mr. Stewart said that they enable the central-station man to be substituted for the iceman. The ice made by these machines is invariably opaque, but its taste is said to be better than that of most clear ice. The smallest machine running but half the time will use about 196 kw-hr. per month; the largest machine will use about 2360 kw-hr. per month, assuming a motor efficiency of 75 per cent. These are typical figures for summer months. In winter, when the load on the central station is, of course, at its heaviest, the demand of the refrigerating machines will be perhaps one-third of that of the summer months. The machines also afford a long hour load, running under ordinary circumstances from six to twenty-four hours a day.

At the same time the refrigerating machine is brought to the attention of the electric-service man as a revenue producer it is offered to the user of refrigeration as effecting an economy as compared with ice. The speaker said that with these machines the energy required to replace 100 lb. of ice varies from 2.6 kw-hr. to 1.6 kw-hr., depending upon the size of the machine. Mr. Stewart pointed out that the ordinary icebox or refrigerator, as used in the home, is very inefficient. Warm-weather tests will usually show that the inside temperature is about 60 deg., whereas it should be 40 deg. to preserve the food in a healthful condition.

The speaker described the use of refrigerated counters in meat markets, restaurants and stores. These counters have glass tops and sides with refrigerated pipes in the rear. The rear space above the pipes is open, giving the butcher or salesman free access. The heavy cold air lies in the space between the refrigerated pipes and the front of the counter, keeping the products displayed in good condition in midsummer weather. A small refrigerating machine operates the refrigerated pipes.

Turning to the domestic field for mechanical refrigeration, the author of the paper mentioned the fact that in a large residence in Philadelphia there was recently removed a 10-ton ammonia machine. This outfit was replaced by three refrigerating machines, the total rating of which was 5 tons. Better temperatures were secured with the new machines than with the old one, in spite of the fact that they were of only half the rating of the older unit. However, the principal objection to the large machine was its noisiness. Mr. Stewart also mentioned the application of the small refrigerating machines to soda-fountain work and the cooling of drinking water. There was a brief discussion, in which the author of the paper said that the gas used in the operation of the machine was sulphur dioxide.

Advertising Irons by Electrically Lighted Billboards

With pictures that endeavor to portray the atmosphere of the average household laundry painted on its electrically lighted billboard spaces, the Union Electric Light & Power Company, St. Louis, Mo., is pointing out

ELECTRICALLY LIGHTED SIGNBOARDS IN ST. LOUIS FOR ADVERTISING IRONS

the advantages of electric irons in many parts of the city. A large colored woman confiding to her sister laundresses that "Dis beats work" forms the central figure of the picture, while the price of electric irons, the name of the electric-service company and the slogan "Iron by wire" are displayed in large letters elsewhere on the billboard.

An Effective "White-Way" Window Display

Following the signing of a contract for installing a system of "white-way" lighting, the Worcester (Mass.) Electric Light Company exhibited in the window of its main office the transparency illustrated in the accompanying halftone, giving the public a concrete idea of the type of lamp and pole shortly to be placed in service throughout the business district of the city. The transparency consisted of a box 33 in. high, 10.5 in. wide and 8 in. deep, containing three 25-watt tungsten

TRANSPARENCY TO DEMONSTRATE STREET LIGHTING

lamps, the latter being placed behind a translucent drawing of the standard lighting unit and pole as shown. Eight 1¼-in. holes in the sides of the box provided ventilation. A feature of the Worcester installation will be the use of street signs on corner poles illuminated by reflection from the arc-inclosing globe above. The transparency shown was designed by the Lundin Electric & Manufacturing Company, Boston.

Motor Sizes to Drive Refrigerating Machines

The term "ton of refrigeration" relates to the quantity of heat extracted during the freezing of a ton of ice from water at 32 deg. Fahr. One ton of refrigeration per twenty-four hours is equivalent to the absorption of nearly 200 lb.-Fahr. heat units per minute. A 1-ton machine will perform work at this rate; that is to say, it will absorb approximately 200 heat units per minute. A 2-ton machine will absorb heat at the rate of approximately 400 heat units per minute. To drive the smaller machines the motor rating required is about 1.5 hp per ton, and for the larger machines from 1.25 hp down to 1 hp per ton. A caution should be added that a "1-ton machine" will not make a ton of ice in twenty-four hours, for it is usual to reckon a 1-ton machine as capable of making a half ton of ice a day, and a 2-ton machine 1 ton of ice, and so on. The reason is, of course, that the water from which the ice is to be made must be first reduced to the freezng temperature, and the ice itself also has its temperature lowered.

Organization and Methods of a Central-Station Sales Department

Before the Milwaukee Electric Railway & Light Company Section of the National Electric Light Association on April 16 Mr. F. D. Beardslee, sales manager of the Union Electric Light & Power Company, St. Louis, read a carefully prepared paper on "Central-Station Sales Department Organization." Mr. Beardslee gave some of the results of his experience in St. Louis. In the sales department of his company there are seven divisions, industrial, commercial, residential, lamp, application, advertising and clearing-house. Each is in charge of a division head who reports directly to the sales manager. The industrial division handles all business in excess of 50-kw connected load and other cases in which it is advisable to have expert engineering knowledge. The commercial division handles general industrial business like stores, factories, etc., where the connected load is less than 50 kw. The duties of the residential, lamp, application and advertising divisions are indicated by their titles. The clearing-house division is used to expedite the work of all the other divisions, and was referred to by Mr. Beardslee as the keystone of the sales department. This division looks out for the contract routine and the passage of all papers and forms from one division to the other so that the delivery of service will be expedited. It also compiles all figures relating to business handled. Meetings are held by the various divisions and the whole sales department to keep the men closely in touch with all phases of the work.

Compensation, Education, Records

Compensation for salesmen is based on length of service, but in addition monthly bonuses are paid to the men obtaining the greatest amount of business during the month. Further, a certain commission is paid on a point system after deducting allowances for demerit points. Demerits are charged where salesmen report incorrect addresses or where they receive certain instructions and fail to carry them out.

Educational courses form an important feature of the work of the sales department of the St. Louis company. Mr. Beardslee described these courses in some detail. Where it is found necessary to fill a position in the sales department the records of the educational classes are examined and men are promoted according to their class ratings.

Carefully kept records of results are on file. It is known, for instance, that the average number of contracts per man for the year 1913 was 403 as against 327 for the preceding year. The cost of getting the business per contract in 1913 was $6.97 as compared with $6.58 in 1912. These figures include all kinds of contracts. For purely new business the cost per contract was $9.07 in 1913 and $11.24 in 1912.

Public Relations and Advertising

The electrical appliance department is not directly under the sales manager, but has a department head reporting to the general manager. But the sales department and the appliance department work together closely.

The speaker laid emphasis upon the paramount duty of the sales-department representatives to cultivate cordial relations with the public. The sales department must have, also, absolute co-operation from the other departments in the company. The head of any department should be broad-minded enough to receive information which will tend to improve the efficiency of his department.

In relation to the development of sales Mr. Beardslee

considered among other things the subject of advertising. He said all advertising copy before being used should be studied thoroughly, especially from the point of view of the reading public. If possible, advertising campaigns should be planned months in advance. When writing copy for an electric-service advertisement it is advisable to lay the copy aside for several days, then take it up again and make a study of it. The manager may be surprised to notice how different the advertisement will appear to him at the second or third reading.

Relations with Contractors

Campaigns for securing connections to "already built" houses are of importance, and Mr. Beardslee described the method adopted in St. Louis. The contracts for wiring are taken by the company and the jobs are then sublet to electrical contractors. A list of contractors is on file in the company's office and each contractor receives approximately $100 worth of work in rotation. By this co-operation the contractors are eager to assist the electric-service company and help to get business. Where a wiring contractor is directly responsible for the receipt of a wiring contract by the electric-service company, the job is immediately sublet to that contractor without affecting the amount of business he will get regularly in his turn.

Selling Water-Power Energy and Electric Signs

Hydroelectric energy was first received in St. Louis, July 1, 1913. It has been found that the most promising market for the sale of this energy is in the steel, ice, electrochemical and cement industries. The difficulties hardest to overcome in securing water-power contracts are cost of change-over, use of steam for other than power purposes, manufacturing by-product used as fuel, minimum-demand charge in case of shutdown, and efficient plant operation for twenty-four hours at a high load-factor.

In relation to electric-sign business, the St. Louis city ordinance is such that all electric signs must necessarily extend up and down the face of the building or be placed on the roof. In some cities electric-service companies employ sign salesmen, but Mr. Beardslee said that this business is usually obtained by close co-operation between the central stations and the sign companies.

Hints in Making Sales

Salesmen for electric-service companies should watch the real-estate transfers closely, as indicated in the newspapers and elsewhere, so that they may follow all leads of this kind for the purpose of securing contracts.

When there is a fire in his district the salesman should get in touch with the customer affected and offer assistance at the old location, or possibly at a new one. The customer should receive special attention at this time, as it will be gratefully remembered in the later dealings between the customer and the company.

Salesmen should be careful about making promises to customers. Salesmen should be very definite and at the same time courteous in handling cases of this kind. Promises made and not kept may cause more harm to a company than going without the business altogether.

Telephone calls should be attended to very carefully and the slips made out at the telephone desk should be in duplicate, one copy going to the salesman and the other being held in the office as a check.

The salesman should be ever on the lookout for new or additional business, but he should never attempt to take advantage of a customer or try to talk him into installing more equipment than he needs. Broad-mindedness and good judgment should be exercised in all cases.

Facts and Factors of Iowa Central Stations

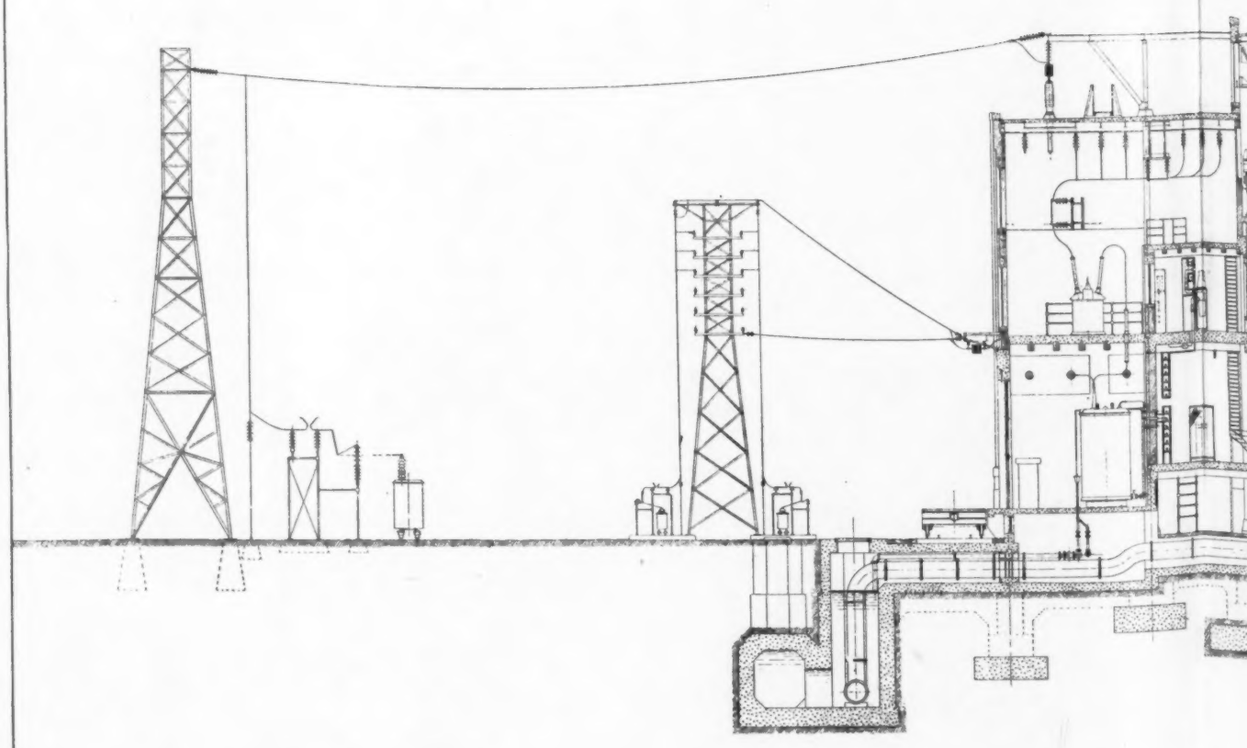
As has been its custom for years, the facts and factors committee of the Iowa State Section of the National Electric Light Association, of which Mr. Austin Burt, of Waterloo, is chairman, presented statistics regarding Iowa central stations at the fourteenth annual convention held at Cedar Rapids, Ia., April 22, 23 and 24. The statistics were compiled by the engineering experiment station of the University of Iowa at Ames, under the direction of Mr. F. A. Fish, and are published on this and the following page.

It was pointed out by Mr. Burt, in explaining the items, that by annual load-factor is meant the kilowatt-hours output for the year divided by the kilowatt-hours output at the station operated at peak load during every hour of the year. The operating load-factor he defined as the ratio of the average load during actual operation to the peak load. The population given comprises the total of all cities, towns and communities served, and the station rating includes in most cases the total rating of all main generators, whether they could all be run at the same time or not. Items 4 and 5 are likely to be high when new generating equipment has recently been added, or in the case of water-power plants with steam auxiliary equipment. The committee said it is probably true that the total connected load given in the tables was derived from estimates rather than from accurate records in more instances than was any other quantity involved in the whole table. The ratio expense to gross income in percentage is naturally variable, and the expense includes operating expenses, taxes and insurance, but no interest or depreciation.

CENTRAL-STATION STATISTICS FOR THE STATE OF IOWA

MUNICIPAL STATIONS

Station Number	Population of District	Number Consumers per 100 Population	Station Rating, Kw	Station Rating per Capita, Watts	Station Rating per Employee, Kw	Ratio Station Rating to Connected Load, per Cent	Average Load During Operation, Kw	Ratio of Average Load to Station Rating, per Cent	Annual Load Factor, per Cent	Operating Load Factor, per Cent	Investment per Kilowatt of Rating	Investment per Capita	Gross Income per Kilowatt of Rating	Gross Income per Consumer	Gross Income per Capita	Gross Income per $100 Invested	Gross Income per Kw-hr. Made, Cents	Ratio Expense to Gross Income, per Cent	Balance, Interest, etc., Not Deducted	Total Hours of Operation per Year
45	750	16.0	35	47	17	95	10.6	30.3	11.2	34.0	229	10.66	92.60	27.00	4.32	40.50	10.8	85.8	5.75	2900
46	1,050	11.5	96	91	47	137	10.2	10.6	13.7	33.0	200	18.28	38.45	30.50	3.51	19.20	9.9	51.5	9.33	3650
47	1,100	13.9	50	45	25	..	....	....	....	....	236	10.72	83.70	27.35	3.80	35.45	....	69.7	10.75	4000
48	3,200	15.3	175	55	29	50	47.8	27.3	30.2	31.6	183	10.00	87.50	31.30	4.78	47.70	3.8	75.0	11.95	8390
49	3,900	18.6	350	90	50	88	39.6	11.3	23.3	24.0	100	9.00	51.80	24.95	4.65	51.80	5.4	67.1	17.00	8500
50	6,500	15.5	500	77	70	96	78.5	15.7	24.5	24.5	180	13.85	....	....	....	....	....	....	....	8750
Average 1914	2,750	15.1	201	68	40	93	37.3	19.0	20.6	29.4	188	12.09	70.80	28.20	4.21	38.90	7.5	69.8	10.96	6030



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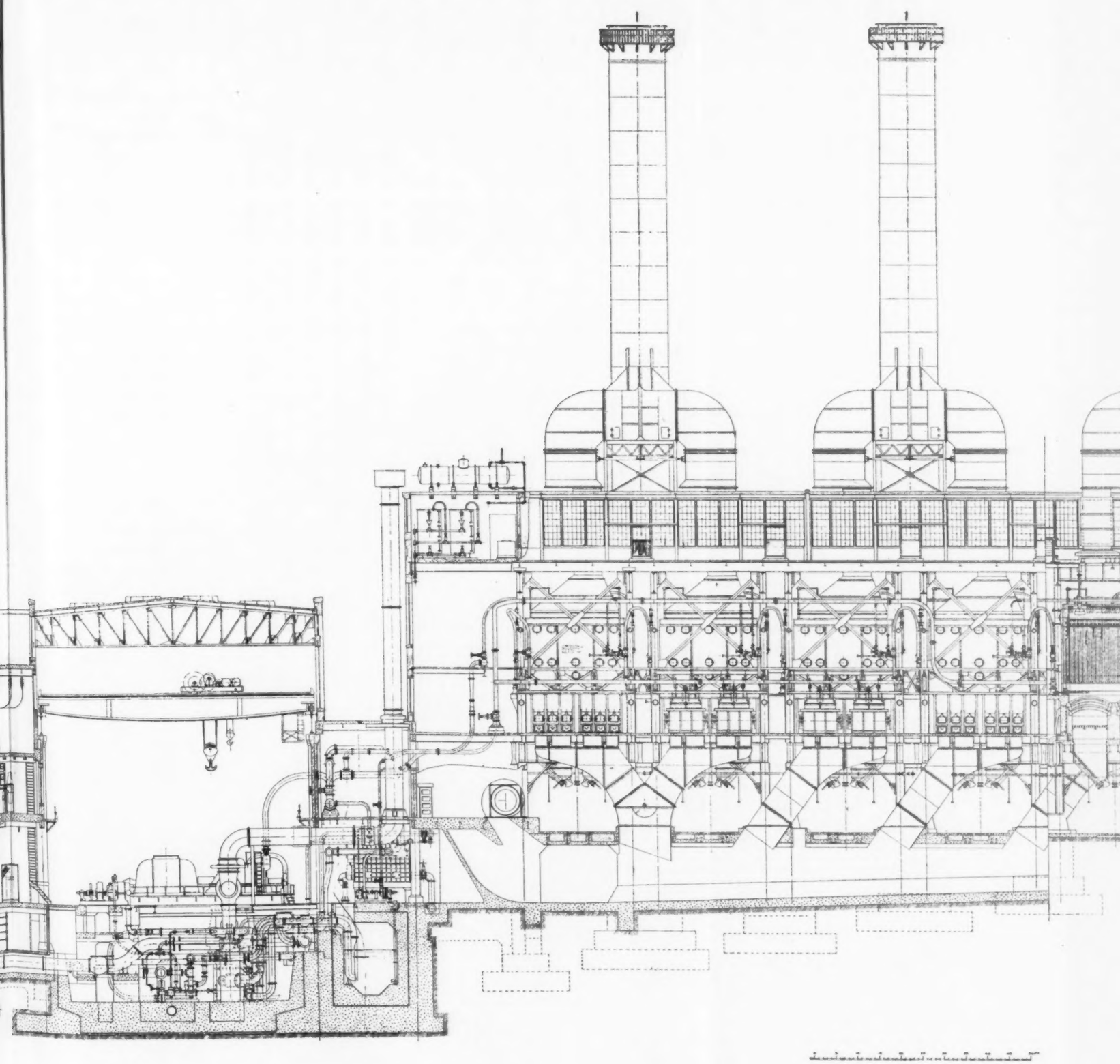
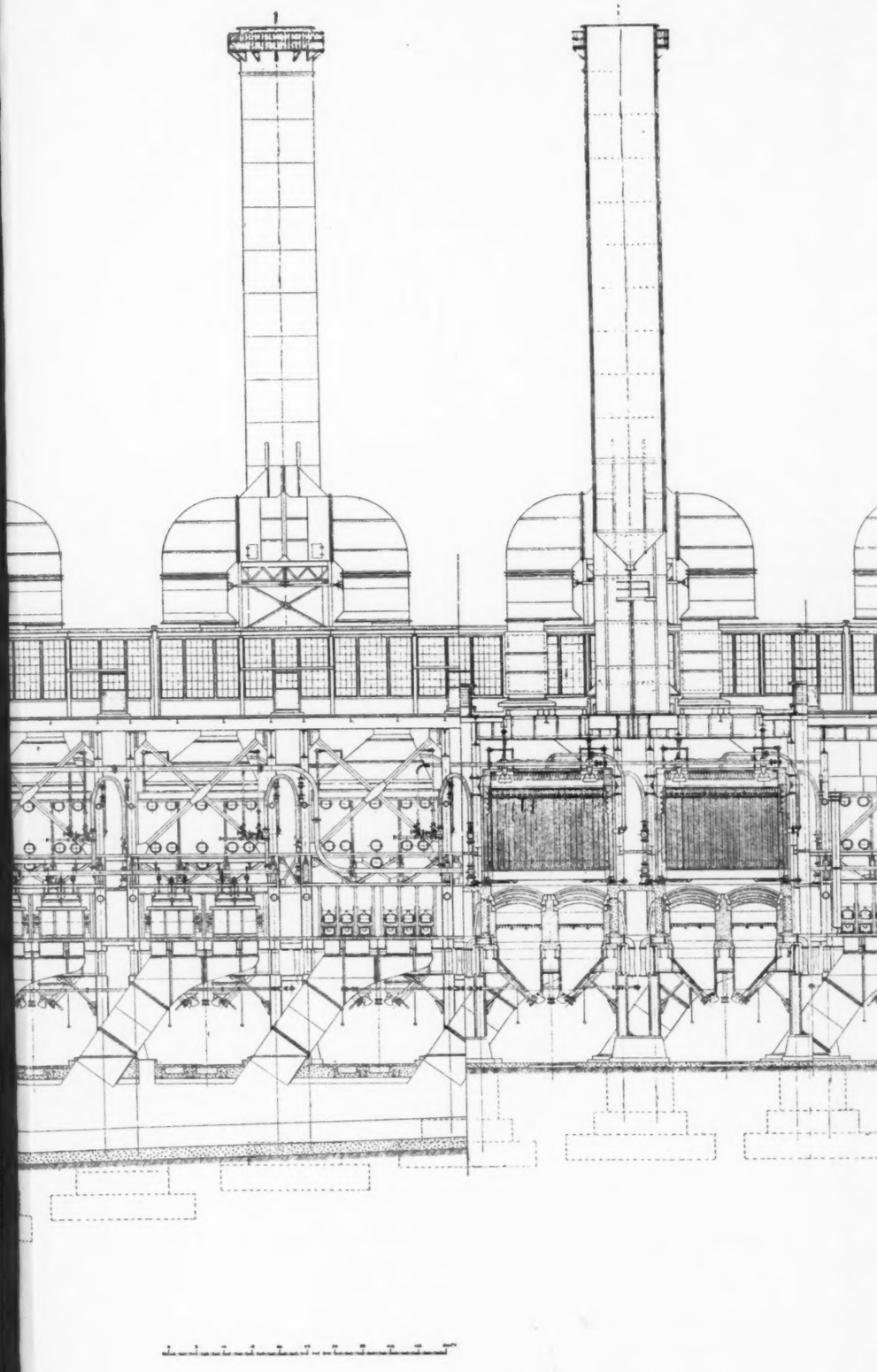
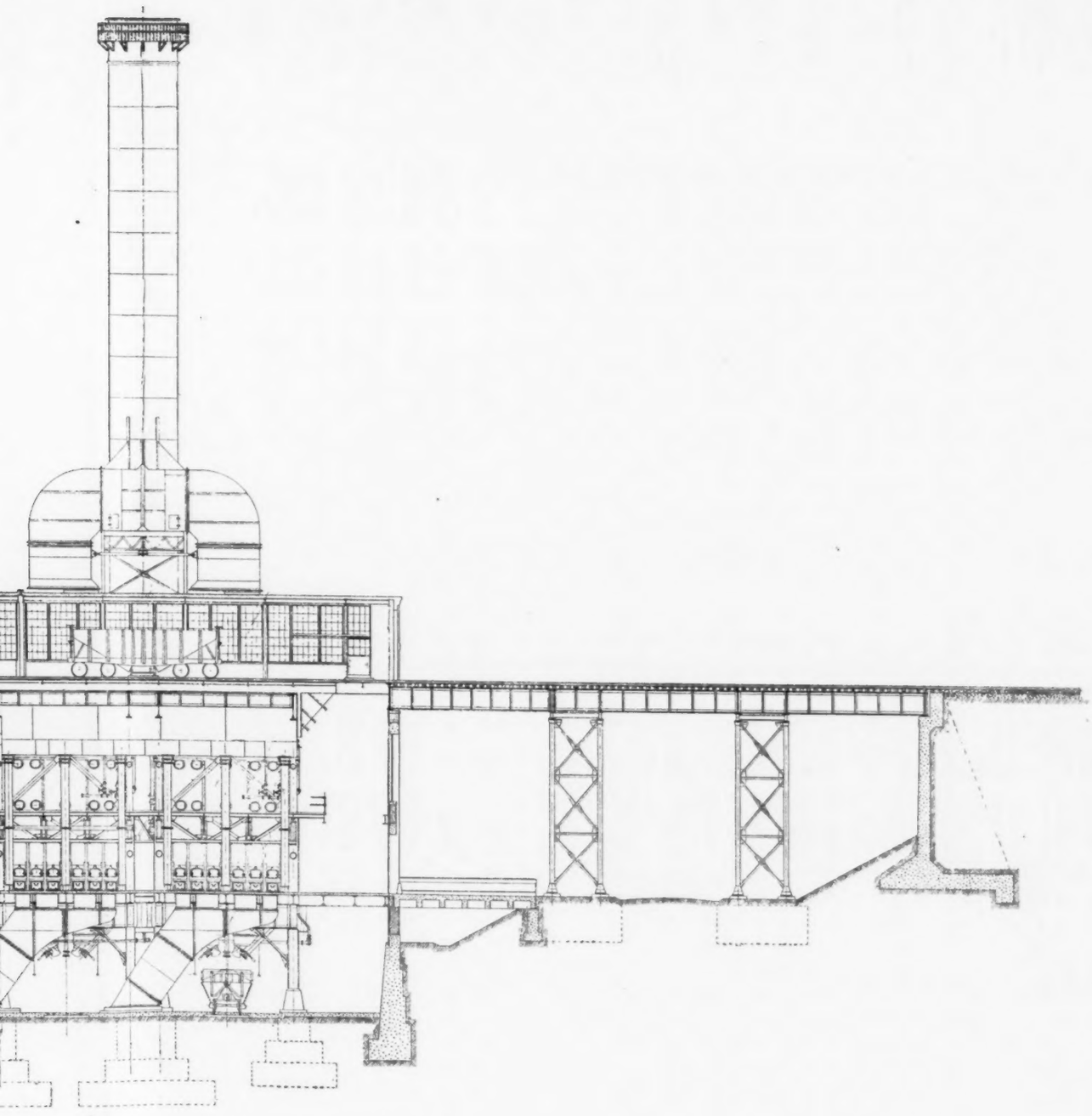


LONGITUDINAL CROSS-SECTION OF HAUTO POWER PLANT, SHOWING COAL-DELIVERY TRACK AND OUTGOING TRANSMIS



-DELIVERY TRACK AND OUTGOING TRANSMISSION LINES AT OPPOSITE



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ARCHIVE

CENTRAL-STATION STATISTICS FOR THE STATE OF IOWA

COMMERCIAL STATIONS

Station Number	Population of District	No. Consumers per 100 Population	Station Rating, Kw	Station Rating per Capita, Watts	Station Rating per Employee, Kw	Station Rating to Connected Load, Per Cent	Average Load During Operation, Kw	Average Load to Station Rating, Per Cent	Annual Load Factor, per Cent	Operating Load Factor, per Cent	Investment per Kilowatt of Rating	Investment per Capita	Gross Income per Kilowatt of Rating	Gross Income per Consumer	Gross Income per Capita	Gross Income per $100 Invested	Gross Income per Kw-hr. Made, Cents	Expenses to Gross Income, Per Cent	Balance, Interest, etc., Not Deducted	Total Hours of Operation per Year
Item No.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1	700	12.8	75	107	37	93	10.0	13.3	34.2	50.0	$200	$21.43	$58.70	$48.90	$6.29	$29.30	7.3	127.1	$16.00	6000
2	750	16.0	75	100	25	250	4.4	5.9	10.5	26.0	173	17.33	38.54	24.08	3.85	22.22	18.5	68.5	7.00	3540
3	1,050	7.9	17	16	17	62	....	....	....	....	400	6.67	167.30	34.30	2.71	40.65	....	77.4	9.15	2500
4	1,100	19.4	75	68	25	..	....	....	....	....	160	10.90	80.00	28.00	5.46	50.00	....	66.7	16.67	8760
5	1,200	14.6	50	42	25	91	10.0	20.0	16.5	22.2	240	10.00	112.20	32.05	4.67	46.75	8.6	85.5	6.75	6500
6	1,200	16.6	75	62	25	37	13.8	18.4	17.3	27.6	224	14.00	100.00	37.50	6.25	44.65	9.9	70.0	13.40	5500
7	1,200	14.2	90	75	90	..	3.5	3.9	....	....	164	12.30	35.70	18.88	2.67	21.75	10.5	69.8	6.57	8760
8	1,200	14.6	50	43	25	28	13.0	26.0	15.0	30.0	400	16.67	154.00	44.00	6.42	38.50	13.9	89.6	4.05	4380
9	1,400	21.4	125	89	42	48	15.0	12.0	23.9	25.0	120	10.72	....	....	....	....	....	....	....	8360
10	1,400	7.0	40	29	40	100	11.0	27.5	8.7	30.0	262	7.50	67.60	27.57	1.93	25.75	9.6	55.5	11.50	2550
11	1,500	13.3	60	40	20	48	25.0	41.7	15.7	50.0	167	6.80	124.20	37.25	4.97	73.05	10.8	84.0	11.66	2750
12	1,500	25.0	125	83	25	..	....	....	....	....	200	16.67	104.60	34.90	8.72	52.30	....	84.5	8.08	8760
13	1,600	20.3	110	69	29	21	72.9	66.0	66.0	75.0	243	16.25	149.10	49.10	9.97	61.40	2.8	46.6	32.75	7710
14	1,600	16.6	200	125	50	67	14.3	7.1	14.4	17.7	125	15.62	53.70	40.70	6.71	42.95	10.5	74.5	10.92	7120
15	1,600	20.0	100	62	33	42	10.3	10.3	12.1	12.1	370	23.10	80.00	25.00	5.00	21.62	8.9	....	....	8760
16	1,700	12.2	175	103	58	70	22.6	12.9	16.9	39.3	131	13.51	47.50	39.95	4.89	36.10	9.8	76.5	8.48	3760
17	2,000	10.3	90	45	30	60	25.8	28.7	12.2	36.8	178	8.00	99.40	43.40	4.47	55.90	11.9	64.0	20.10	2900
Average 1914	1,337	15.4	90	68	35	73	18.0	21.0	20.2	34.0	221	13.40	92.00	35.35	5.31	41.40	10.2	76.0	10.61	5800
Average 1913	1,416	14.2	88	61	28	56	20.2	26.6	....	30.2	216	10.93	93.28	31.96	5.43	51.51	11.6	66.6	18.51	4871
Average 1911	1,415	11.9	82	62	36	94	19.4	26.3	....	33.8	205	11.03	84.30	48.20	4.33	43.50	10.9	73.4	6.23	4840
Average 1909	1,600	10.0	67	42	27	94	....	....	....	36.0	236	10.00	94.00	37.00	4.06	38.00	....	70.0	....	....
18	2,200	15.9	140	64	47	42	16.9	12.0	21.9	23.2	171	10.85	92.50	37.00	5.89	54.20	9.2	55.4	24.15	8260
19	2,400	12.1	130	54	26	26	20.0	15.4	20.9	22.2	215	11.66	76.90	34.50	4.17	35.70	6.1	80.0	7.14	8260
20	2,500	22.9	160	64	26	23	56.6	35.3	37.7	37.7	237	15.20	127.90	35.75	8.20	53.90	4.1	72.2	15.00	8760
21	2,900	15.7	190	65	38	26	14.9	7.8	15.0	15.0	225	14.74	62.40	26.00	4.09	27.70	9.1	63.7	10.05	8760
22	3,000	20.0	100	33	25	33	37.0	37.0	34.9	35.0	250	8.33	166.67	27.80	5.55	66.67	5.2	72.0	18.65	8740
23	3,000	16.6	210	70	35	47	26.3	12.5	27.6	27.7	166	11.63	66.40	27.90	4.65	40.00	6.1	89.2	4.30	8740
Average 1914	2,667	17.2	155	58	33	33	28.6	20.0	26.4	26.8	211	12.07	98.80	31.50	5.42	46.40	6.6	72.1	13.21	8600
Average 1913	2,437	16.6	163	67	36	43	27.1	16.7	....	27.4	201	12.88	105.40	41.53	6.76	58.10	8.0	75.6	16.46	8573
Average 1911	2,650	12.7	157	60	29	55	28.4	25.1	....	33.0	190	10.61	83.20	37.40	4.52	41.90	5.7	76.1	8.39	7620
Average 1909	2,470	10.0	122	44	38	48	....	....	....	....	221	9.40	95.00	43.00	4.04	41.00	....	63.0	....	....
24	3,500	12.8	300	86	60	50	53.7	17.9	27.1	29.0	150	12.85	68.60	45.70	5.88	45.70	4.7	67.8	14.71	8200
25	3,850	13.1	400	104	44	..	....	....	....	....	237	24.60	47.90	38.00	4.98	20.20	....	88.8	3.73	8760
26	4,200	17.3	285	68	28	35	....	....	....	....	141	9.60	82.30	32.30	5.58	58.20	....	58.9	23.88	8200
27	5,000	10.8	270	54	30	30	57.0	21.1	19.0	19.0	333	18.00	119.00	59.60	6.43	35.73	6.4	58.9	14.70	8760
28	5,000	13.2	190	38	31	40	28.6	15.0	25.9	25.9	263	10.00	113.40	32.70	4.31	43.10	8.6	74.2	11.10	8760
29	5,200	19.0	1040	200	62	50	152.0	14.6	38.0	38.0	120	24.00	52.40	55.00	10.47	43.60	4.1	68.7	13.60	8760
30	6,000	10.1	380	63	47	50	22.2	5.8	14.8	14.8	158	10.00	50.40	31.50	3.19	31.90	9.9	79.2	6.62	8760
31	7,000	18.9	300	43	33	43	78.0	26.0	20.8	20.8	300	12.85	136.30	31.00	5.84	45.45	6.0	50.9	22.32	8760
32	7,000	14.7	875	125	125	62	30.8	3.5	13.7	13.7	343	42.85	27.45	23.43	3.43	8.00	8.9	41.1	4.71	8760
33	8,000	12.0	590	74	37	39	68.5	11.6	24.8	24.8	495	36.60	112.00	68.80	8.28	22.60	11.0	68.0	7.24	8760
Average 1914	5,475	14.2	463	86	50	44	61.4	14.4	23.0	23.3	254	20.14	80.97	41.80	5.84	35.45	7.5	65.7	12.12	8648
Average 1913	4,550	12.9	277	61	33	66	36.7	21.4	....	33.0	222	12.67	116.16	52.78	7.06	61.76	7.7	63.4	25.81	7379
Average 1911	4,580	11.5	239	53	33	74	42.1	18.0	....	26.7	248	12.30	88.50	38.75	4.46	38.25	6.8	67.1	11.95	7720
Average 1909	5,670	10.0	285	51	37	50	....	....	....	....	202	10.00	85.00	42.00	4.40	49.00	....	56.0	....	....
34	10,000	13.4	725	72	20	51	117.0	16.1	25.0	25.0	388	28.10	75.70	40.85	5.49	19.53	5.4	65.5	6.73	8760
35	10,750	14.3	1100	103	27	77	143.2	13.0	29.0	29.0	454	46.52	55.45	39.60	5.67	12.20	4.9	62.0	4.63	8760
36	11,000	13.6	2000	182	74	133	228.0	11.4	45.6	45.6	342	62.20	35.67	47.50	6.48	10.42	3.6	52.8	4.91	8760
37	12,000	10.4	950	79	47	95	113.0	11.9	26.9	26.9	....	....	....	....	....	....	....	....	....	8760
38	17,000	11.8	850	50	61	40	202.3	23.8	30.0	30.0	470	23.40	113.70	48.35	5.70	24.30	5.4	49.0	12.40	8760
Average 1914	12,150	12.7	1125	97	46	79	160.7	15.2	31.3	31.3	414	40.10	70.10	44.10	5.84	16.60	4.8	57.3	7.17	8760
Average 1913	17,060	7.2	1080	63	119	56	215.0	20.0	....	29.7	579	27.47	82.55	64.07	4.27	60.55	4.9	50.3	16.13	8760
Average 1911	14,500	8.4	1206	92	128	70	141.0	14.1	....	22.6	277	18.70	65.70	52.95	4.27	24.10	5.5	54.7	10.71	8760
Average 1909	15,500	5.0	775	50	71	67	....	....	....	22.0	139	8.00	60.00	60.00	3.20	54.00	....	71.0	....	....
39	25,000	9.7	1000	40	33	23	323.8	32.4	32.4	32.4	310	12.40	128.60	53.20	5.15	41.50	4.5	44.1	23.20	8760
40	26,000	7.7	3000	115	176	27	582.0	19.4	35.9	35.9	177	20.38	67.95	102.40	7.84	38.45	4.0	55.0	17.30	8760
41	30,000	13.3	2700	90	77	44	380.0	14.1	31.6	31.6	....	....	....	....	....	....	....	....	....	8760
42	38,000	12.2	4225	112	78	47	667.0	15.8	29.0	29.0	286	31.80	56.60	51.50	6.29	19.70	4.1	51.4	9.60	8760
43	45,000	6.6	5000	111	111	90	862.0	17.2	30.0	30.0	195	21.70	42.65	72.30	4.74	21.80	2.8	41.2	12.84	8760
44	117,000	7.6	8850	76	49	51	1675.0	18.9	35.0	35.0	339	25.60	66.55	66.70	5.03	19.62	4.0	....	....	8760
Average 1914	46,830	9.5	4130	91	87	47	748.3	19.6	32.3	32.3	261	22.40	72.50	69.20	5.80	28.20	3.9	47.9	15.73	8760
Average 1913	44,500	7.5	3120	64	209	56	593.0	24.4	....	24.3	326	19.91	81.35	71.10	4.52	28.22	4.1	50.6	13.03	8760
Average 1911	55,600	6.2	2890	51	81	43	653.0	22.7	....	31.5	541	27.20	80.50	68.90	4.17	15.27	4.1	48.9	8.26	8750
Average 1909	53,000	5.0	2110	46	262	42	....	....	....	24.0	195	9.00	88.00	79.00	3.50	42.00	....	51.0	....	....
Grand Av. 1914	9,890	14.3	852	77	46	57	159.2	18.5	25.2	30.0	251	18.40	85.80	41.35	5.57	36.70	7.6	67.9	14.57	7565
Grand Av. 1913	11,400	12.5	778	61	71	35	155.0	23.2	....	29.3	255	14.23	93.50	49.90	5.74	50.60	8.2	63.6	19.00	6950
Grand Av. 1911	14,920	10.6	576	64	51	72	117.0	22.0	....	30.1	252	13.85	82.10	47.60	4.36	36.80	7.8	67.5	9.82	6710
Grand Av. 1909	9,411	9.0	401	44	63	56	....	....	....	32.0	220	9.60	89.50	46.00	3.93	41.60	....	64.0	....	....

Illumination and Wiring

Effective Electric Sign on Dry-Goods Store

The electric sign illustrated herewith, recently installed over the main entrance of a Cambridge (Mass.) dry-goods house, faces an important square and street-railway transfer point and combines fixed and flasher operation in an attractive manner. The sign is 31 ft. long and about 18 in. wide, and its principal feature is a flashing arrow equipped with forty-six 5-watt clear-

DRY-GOODS STORE SIGN, CAMBRIDGE, MASS.

bulb outline lamps which emphasize the name of the store, the latter being featured as a transparency lighted by fourteen 5-watt lamps on the inside of the sign. The arrow is about 15 ft. long and its band is illuminated from within by twenty 25-watt lamps which emphasize the slogan of the store. The face of the sign is black, opalux letters being used in the wording, with a green background for the band of the arrow. Energy is supplied by the Cambridge Electric Light Company.

Illuminated Counter for Examining Negatives

An effective home-made arrangement to facilitate the examination of photographic negatives by customers has been developed by Mr. James H. King, a com-

ILLUMINATED COUNTER FOR EXAMINING NEGATIVES

mercial photographer at 309 Washington Street, Boston, Mass. As illustrated herewith, the device consists of a depression 18 in. long by 11 in. wide and about 1 in. deep in the counter of the reception room, the opening being closed by a plate-glass top and a ground-glass bottom. Beneath the latter are installed three 20-watt tungsten lamps controlled by a snap switch at one side. At the rear of the depression are divisions marked one each, two each, etc., up to five, so that time can be saved and accuracy conserved in selecting the number of prints to be made as the customer examines his negatives. The location of the lighting device in the counter enables negatives to be examined with speed and comfort and the cost of operation is nominal.

Lighting the Bill-of-Fare Electrically

A Boston restaurant in the Beacon Hill district has added materially to its patronage by posting its daily menu out of doors on the wall adjoining the entrance to the establishment and equipping the bulletin with a 16-cp tubular incandescent lamp shaded from the eye by a tin reflector with a white-enameled inside surface. The reflector diameter is 3¼ in., and the bulletin measures 8 in. by 12 in. A hinged and padlocked cover with plate-glass window protects the menu from the weather and facilitates changing the card at noon and night. As the street is rather dimly lighted after

ILLUMINATED MENU OF A BOSTON RESTAURANT

dusk, the illuminated list of viands set forth to tempt the pilgrim and the stranger stands forth conspicuously and illustrates the drawing power of a well-designed bit of electrical display advertising.

Tungsten-Lamp Renewal Arrangement in Chicago

Following the recent announcement of reduction in the price of tungsten lamps, the Commonwealth Edison Company of Chicago advertises that those customers whose contracts for electricity provide for the free renewal of standard carbon lamps may obtain 60-watt tungsten lamps free of cost under the following conditions: Upon the surrender to the company of burnt-out standard carbon lamps (etched and with bulbs intact) the customer will be entitled to receive in exchange for two such lamps (1) two new standard carbon lamps free, or (2) one standard carbon lamp and one standard tungsten lamp of 60-watt or larger size free, or (3) one standard tungsten lamp of 60-watt or larger size free and one other tungsten lamp at a specified price. Upon the surrender to the com-

pany of a burnt-out tungsten lamp of 10-watt or larger size (etched and with the bulb intact) the customer will be entitled to receive in free exchange therefor a standard tungsten lamp of 60-watt or larger size. The reduced exchange prices for standard tungsten lamps are now as follows: 10-watt lamps, 24 cents each; 15-watt, 21 cents; 20-watt, 16 cents; 25-watt, 14 cents; 40-watt, 12 cents; 60-watt, 10 cents. No charge is made for 100, 150 or 250-watt tungsten lamps.

Some Present Street-Lighting Problems

BY J. R. CRAVATH.

The scientific study of the production of satisfactory interior illumination has progressed much more rapidly than that of street lighting, and certain features of the latter are very much in need of investigation on a more scientific basis than has yet been attempted.

One of the principal problems involved is that relating to the question of large versus small units. It is important to know how far it is desirable to go in reducing the size and shortening the distance between lamps. The relative cost of a given quantity of light delivered from large as against small units of course has an important bearing on the ultimate solution of the problem. However, before any such ultimate solution can be reached in any case it is necessary to know the relative practical illumination values to the user of the street of the various possible arrangements of large and small units from a purely illumination standpoint, leaving out of account the cost of production.

For many years exclusive use was made of large and efficient light units such as the arc lamp on the one hand and the much less efficient small incandescent unit on the other. Recently the old limitations have been removed, and their removal opens up an unexplored field in the production of street-lighting effects. Thanks to the tungsten lamp, a large range of sizes of efficient lamps exists, and the methods have been perfected for more economically distributing electrical energy to small units than formerly where underground service is required. There is now an abundance of new tools, but one does not know yet how best to use them. One cannot say with certainty, for the lighting of any given length of street with a given amount of light flux available, what sizes of lamps and spacing will give the best illuminating effect. It is probably safe to state that a majority of the leaders in the field of illumination would have been much more certain of the correct answer to a problem of this kind several years ago than they are at the present time, some of the most important considerations in street lighting usually not having had sufficient weight in years past. In 1910 Mr. Preston S. Millar, in a paper read at the Illuminating Engineering Society convention, called attention to some neglected considerations pertaining to street illumination, and since then one has come to realize adequately how much of one's seeing along streets at night is attributable to the silhouette effect. In other words, pedestrians and vehicles are seen very largely because they are silhouetted as dark objects against a lighter background which reflects the light from the lamps along the street. Even in the best lighted thoroughfares the silhouette effect is very important, while it constitutes about the only method of distinguishing objects along the greater portion of the more dimly lighted streets.

It is easy to determine the probable intensity of illumination on a street or sidewalk surface from given sizes and spacings of lamps, and the probable surface brightness of different portions of the street can be arrived at by calculation after a sufficient number of tests have been made on the diffuse reflecting power of the street surface. From this one might suppose that it is a simple matter to calculate theoretically the street surface brightness resulting from different sizes and spacings of lamps and so to determine their relative value in producing the desired silhouette effect, just as one can calculate theoretically the amount of illumination on vertical objects. For many years the vertical illumination was the only one that received consideration from many engineers. Much of the value of the calculations of street surface brightness, however, is uncertain because of the fact that in viewing any vertical object along the street it is seen silhouetted against a background of street which may cover a considerable distance ahead and probably consists of alternate patches of light and dark pavement.

The question that arises is, Can an object be seen better against a uniformly illuminated background, such as would be obtained with small lamps at frequent intervals, or with a background much less uniform with occasional spots much brighter than in the first case, such as would be obtained by an equal total flux of light from lamps spaced at longer intervals? The effect on the eye of the street user produced by these different sizes and spacings of lamps cannot be calculated theoretically from information now available. The effect is both physiological and psychological. The only way to determine these uncertain factors is by making an actual test on the street in such a way that different arrangements can be compared directly. For this purpose similar converging streets would have to be equipped with lamps for a distance of from 0.25 mile to 0.5 mile from their convergence. The light flux per foot of street should be the same in all cases if results of real value are to be obtained. In such experiments it is necessary that the streets under comparative test converge, so as to admit of quick and easy comparisons, since it is a notorious fact that the eye has no memory so far as illumination values are concerned. After the fundamental requirements are determined in this manner the light flux per foot of street could be so varied as to present for direct comparison different systems of equal annual cost per foot of street illumination.

Certain extreme conditions are not in need of investigation because they have already been used many times and are matters of common casual observation. For example, it is well known that large units such as arc lamps spaced from 600 ft. to 1000 ft., as in hundreds of small towns, do not provide satisfactory street illumination. An equal amount of light flux, small though it may be, scattered along the street from small units is known to be more satisfactory. One does not know, however (for the reasons before explained), how far it is desirable to go in reducing the size of the lamp and shortening the spacing.

For the reasons mentioned before it is believed that street lighting cannot be judged either by the average or by the minimum illumination midway between lamps alone. Perhaps a low minimum illumination may be compensated for partially by the bright background afforded by the greater illumination under each lamp if the interval between lamps is not too great.

Considerable discussion has taken place in England on standard specifications for street lighting proposed by Mr. A. P. Trotter in 1913. These specifications in brief were that the minimum horizontal illumination at any point along the illuminated street should be taken as the basis of contract. Strong exceptions were taken to this proposed specification in the lengthy discussions upon it in the (British) Illuminating Engineering Society, and the defects of the proposed plan

were also pointed out editorially in the *Electrical World* on May 10, 1913.

In view of the importance of silhouette effects in street lighting it is very improbable that good street lighting can be judged by minimum values alone. While it is known that brightly lighted areas under large lamps produce light backgrounds which are of decided assistance both in the apparent and in the effective illumination of the street, it is known, on the other hand, that if these lamps are far enough apart a point is reached where the extreme contrast between these brightly lighted areas under the lamps and the dark areas between lamps tends to confusion and interference with vision. The fundamental problem is to determine how far the average illumination along the street can be raised above the minimum illumination at the darker parts before the detrimental effect of too much contrast overbalances the helpful effects of the better illuminated patches of background which the higher average of illumination will give.

Another question which could profitably be investigated in the course of such experiment would be the proper height of lamp with different spacings of lamp-posts. Usually the height is limited in residence streets by trees, but for streets where there is no such limitation this question needs further study. It is well established that glare from street lamps interferes with or reduces the ability to see with a given illumination of the street surface. The actual effect on the street with different lamp heights can be determined only by actual street experiments where just comparison can be made simultaneously, or nearly so, by a number of observers, technical and non-technical.

A third point for fruitful experiment is that of shades and reflectors for street lamps which will minimize the glare effect of distant lamps without restricting too much the area illuminated from one lamp.

In view of the increasing amount of money spent annually for street lighting the expense of such tests (although considerable if properly carried out) would be amply justified, since an immense amount of money will be wasted during the next few years through the ineffectiveness of street lighting unless some of these fundamental determinations are made.

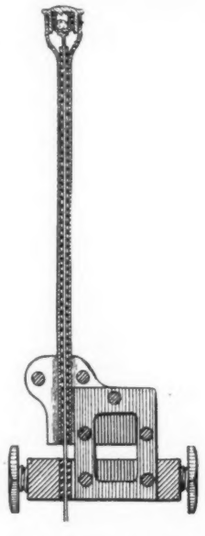
Manufacture and Testing of Insulated Wire and Cable

Mr. H. A. Morss, of Boston, Mass., vice-president of the Simplex Wire & Cable Company, gave an interesting and instructive talk on the insulation and testing of wires and cables before a number of the employees of the Commonwealth Edison Company, Chicago, at the rooms of the Western Society of Engineers on Feb. 17. Taking the bare copper wire from the time of its arrival at the tinning bath, the speaker traced the various steps in the process of insulation to their completion, illustrating his talk with lantern slides showing the machines employed for tinning, tarring, braiding, applying cotton and jute, insulation, stranding copper cores and protective armor, placing rubber insulation, sheathing cable with lead, taping cable and winding steel tape on steel-taped cable. Processes of masticating and drying rubber preparatory to mixing it with other insulating ingredients were also described and illustrated.

In answering questions asked at the close of the lecture Mr. Morss said that he did think wire made fifteen years ago was in some instances better than the products of the factories of to-day, for the reason that competition has forced the manufacturer to bring out wire which is of a lower quality but which is quite good enough for the use to which it is put. He said further that voltage tests on cambric-insulated cables have shown that this type of insulation is really unfit for use where high temperatures are liable to occur. In speaking of testing methods, Mr. Morss emphasized the fact that the manufacturer does not follow the rule of applying a potential two and one-half times the rated voltage for testing all sizes of wires and cables, but uses higher voltages for larger cables in order to bring out possible faults which might come to light later in operation. For instance, the speaker said a No. 14 wire with a 0.047-in. wall, designed for 600-volt operation, is tested at two and one-half normal voltage, or 1500 volts, while a 1,000,000-circ. mil cable with an insulating wall 0.092 in. in thickness, intended for a working pressure of 600 volts, is subjected to a factory test of approximately 5000 volts to search out possible faults.

Recent Telephone Patents

Among the successful selective signaling schemes in use are those based upon the so-called harmonic principle, wherein different frequencies of alternating current are used for different stations, the corresponding ringers being tuned each to respond to its own frequency. One of the peculiarities of these systems lies in the fact that the vibrator changes its normal vibration period whenever the recoil of any stop piece is introduced. For a bell, therefore, the tuning must be



HARMONIC RELAY

slightly off, although it must be sufficiently close for the vibrator to start and to make a first stroke against the stop. Further, the reed must not be out of step when speeded by the recoil. With these conditions in mind Mr. Kempster B. Miller, of Chicago, has devised a system in which the harmonic vibrator has free swing. He uses the vibrator as a relay to control the bell circuit. This relay, which forms the subject of a patent granted to him and assigned to McMeen & Miller, will be understood by reference to the cut, which shows the vibrating part. The chamber at the upper end contains mercury which under the agitation of the vibration closes the relay contact.

Mr. A. B. Buckland, of Rochester, N. Y., has inclosed his antiseptic device in a sheet-metal annulus which clamps over the lip of the mouthpiece.

Letters to the Editor

For a Chain of Amateur Wireless Stations

To the Editors of the Electrical World:

SIRS:—The Radio Club of Hartford, Conn., has been at work for some time on plans to organize one or two good amateur wireless stations every 30 to 50 miles throughout as much of the country as seems practicable. The object is to make it possible to relay messages between distant points.

The plan has already reached a point where messages are being relayed from Hartford to Buffalo, N. Y., via Northampton, Mass., and Westfield, N. J. In a short time we expect to get through to Chicago by this relay system. All we need is to get in touch with those amateurs who have stations which will transmit at least 30 miles and who keep their station in continuous working order.

As a means of getting the names and addresses of amateurs who have stations able to transmit messages 30 miles, such amateurs are asked to write to Mr. Clarence D. Tuska, secretary Radio Club of Hartford, 136 Oakland Terrace, Hartford, Conn., who will forward blank forms which when filled out will be used as a basis for appointing official relay stations of the American Amateur Radio League, the name of the organization as already started.

The writer is taking an especial interest in this work and it has his hearty support, especially as it seems to be the only plan by which the amateur can reach distant points without getting into difficulties with the United States government. It may be that we have in this idea a great organization in the making.

Hartford, Conn. HIRAM PERCY MAXIM.

The New Learning

To the Editors of the Electrical World:

SIRS:—Is the attribute of learning properly accorded to the man whose higher education has been entirely along technical and scientific lines? In other words, has the engineering profession made good its right, as the faculties of law and medicine long ago did theirs, to share the laurels of erudition with purely scholastic callings? Here is a question that might be commended to debating societies, for in nothing have the changes in human evolution been more clearly marked than in the slowly shifting standards of a liberal education. In medieval times the learned man of the Western world was he who, steeped in patristic Latin, split hairs upon the minute creedal subdivisions of a fantastic theology. Then the Renaissance dawned, and education gradually came to mean proficiency in Greek and Latin with mathematics, philosophy and the new-born literature as subsidiary branches. The classics long retained their supremacy. It is only necessary to glance at the prose writings and the parliamentary speeches of the eighteenth and the early part of the nineteenth century to perceive how education was bound up with knowledge of ancient literature and mythology. Yet when, some years ago, a scholarly Massachusetts statesman ventured to declaim a few lines from Virgil in the Senate chamber of the United States his colleagues gasped and consternation struck the copy-editing rooms of the morning newspapers. The times had changed, and the qualifications of senators and editors had changed with them.

Much the same thing seems now to have taken place concerning modern literature in its higher branches. Those whose school days are dated back a generation or more can remember the first formidable inroads of physical science on the ground where formerly the humanities were firmly intrenched. That was the period of Darwin and his illustrious coadjutors; but electricity was still in its swaddling-clothes and latter-day engineering was taking its first faltering steps. In those days the erudite man was he who had perchance comprehended Kant's "Critique," edited an encyclopedia, or applied his mind to memorizing historic details all the way from the siege of Troy to the siege of Paris.

That along with specialized acquirements of this nature there existed an extensive knowledge of the magnificent prose and poetry of the English language was taken for granted. It was, indeed, the possession of thousands with no pretence to scholarship, and it served as the foundation stone for every structure erected in the name of learning by men to whom that tongue was native. *Mutatis mutandis*, the same thing was doubtless true of men of other tongues. Scholars might become absorbed eventually in one division or subdivision of knowledge, but the price of mastery was not an early and complete limitation of the scope of effort.

Once again "we have changed all that." Abstract reasoning makes small appeal to the twentieth-century youth. Literature, though happily it will always have in plenty its devotees, is in some danger of being relegated to the status of a cult, one of the fine arts, along with music, painting and sculpture. The day of the engineer has arrived, and in schools and colleges mathematics holds first place in undergraduate favor—not so much by virtue of its inherent merits as because it is the foundation of and supplies the formulas for the score of practical sciences that modern invention has caused to grow up around it. Here is the path along which the ambitious and enterprising youth finds himself drawn. If, in addition, he applies himself to the study of the modern tongues, it is for a cognate reason. His French is acquired not in order to get the fine flavor of Molière's comedy or to examine the epoch-making philosophy of Voltaire, but to enable him to know what light the analytic genius of France has to throw on scientific problems; his German is not for the purpose of grasping the subtleties of "Faust," but to keep pace with Germany's strides in the development of natural forces; his Italian is not that he may explore hell, purgatory and heaven with Dante, but that he may follow the achievements of the native disciples of Pacinotti and Marconi; while his Spanish is not used to savor in their Iberian idiom the racy speeches of Sancho Panza, but in learning of the vast industrial potentialities of South America.

To such a student once master of his subjects, so far as subjects so pulsating and expanding can be mastered, there must no longer be denied the distinction of the learned, even though to him, perhaps, Emerson and Browning be only names and philology and rhetoric incidental pursuits of small import. It is well, of course, to urge him to broaden his mind by excursions into other intellectual realms than those he has made his very own. But versatility is a rare quality and a tireless mind an endowment of the few. The twentieth century is a utilitarian one and one which all men hope is making, however blindly, for the amelioration of the race. From both these points of view, as well as from that of difficulty of performance, surely the mental acquirements of the man who has learned how to throw a bridge across a mile of water, or to harness Niagara to a street car 200 miles away, or to equip a great electric power house to stable the strength of a million horses, do not deserve to be ranked below those of the translator of Homer, the exponent of metaphysics, or the commentator on Shakespeare's sonnets.

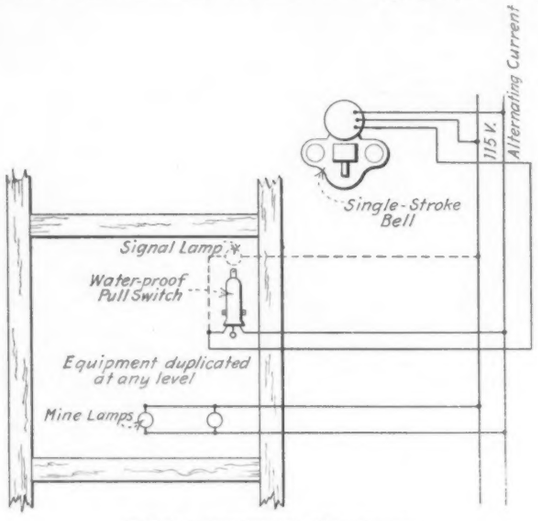
New York, N. Y. FRANK C. WELLS.

Field of the Operating Engineer

A Record of Practice, Experience, New Ideas and Interesting Problems—Notes on Practical Subjects—Questions and Answers

Mine Signals and Lamps on Same Circuit

Shown in the accompanying diagram is an alternating-current mine-signal wiring system for use in single-compartment shafts. Mine lamps can be connected to the same circuit. Single-stroke bells, waterproof pull switches and insulated circuits are employed, so there



SIGNAL SYSTEMS FOR MINES

is little possibility of the bells being accidentally rung or current straying through the earth and causing sparks or explosions. The conductors should be rubber-covered and preferably inclosed in weatherproof or lead-covered cable. This system is employed in the Cripple Creek Mines, Colorado.

Blown Compensator Fuse

When a polyphase induction motor is started from a plain triple-pole, single-throw switch (small motors usually are), or from an external resistor and controller, or from an internal-resistor and switch device, the supply lines are fused, so that the fuses are in circuit all the time. This is practicable where the motor is small, or where the starting current is under control, or where the motor is never required to start with a heavy connected load. When an induction motor is operated from a compensator, however, it is customary to fuse only the motor side of the compensator, because fuses of a size that would be of any protection to the motor under ordinary running conditions would blow when subjected to the starting currents incident to compensator control. An inspector was called to locate trouble with a 35-hp, three-phase induction motor that would always start when the compensator was closed on the starting side, but would sometimes stall when the compensator was thrown over to the running side. The trouble proved to be due to a blown fuse, and the explanation of the motor's action is as follows: The motor's connected load was a centrifugal blower. With the blower damper closed the load was very light and the motor would start promptly and operate comparatively free. With the blower damper open, however, the load was heavy and increased rapidly with the speed. In the first case the motor would come up to nearly synchronous speed on the starting side of the compensator so that when the compensator was moved to the running position the speed was so high and the load so light that the motor would continue to operate, but as a single-phase motor; in the second case the connected load would prevent the speed from getting near synchronism on the starting side of the compensator, and on throwing the compensator to the running side the load would become too great and the speed too low for single-phase action to pull the rotor into synchronism, so it would stall and blow more fuses. The operator would then replace the fuses, not knowing, of course, that one of them had been blown perhaps for some time, and everything would then run along all right until the next fuse blew from age or overload, when the same erratic cycle would be irregularly repeated. The motor was installed above the compensator, access to it being by a ladder. Had it been placed where the operator would have had occasion to rest his hand upon it in passing, he would have probably noticed that the motor became a good deal warmer on some days than it did on others, because a three-phase motor operating single-phase takes about a third more current.

Construction of 11,000-Volt Switch Tower

The solution of the 11,000-volt switching problem described herewith is of interest because of the peculiar construction necessary to mount the apparatus in restricted space so that the taps would have maximum

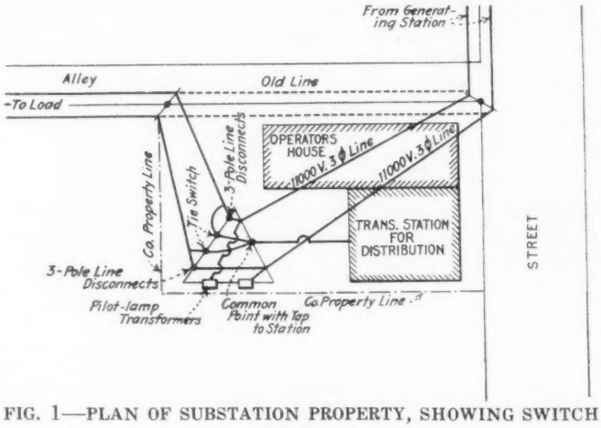


FIG. 1—PLAN OF SUBSTATION PROPERTY, SHOWING SWITCH TOWER

clearance while at the same time making the switches as accessible as possible.

Two loaded 11,000-volt, three-phase lines of the Northern Indiana Gas & Electric Company passed through a town in which there was a transformer substation. This station was equipped with pole-top switches so that it could be fed from either line. Later

the company decided to provide switching means, with pilot-lamp transformers on both lines, so that in case one of the lines went bad between his station and the generating plant the substation operator could quickly shift the load to the other line.

The engineer who designed the switch tower was handicapped by the amount of ground space available

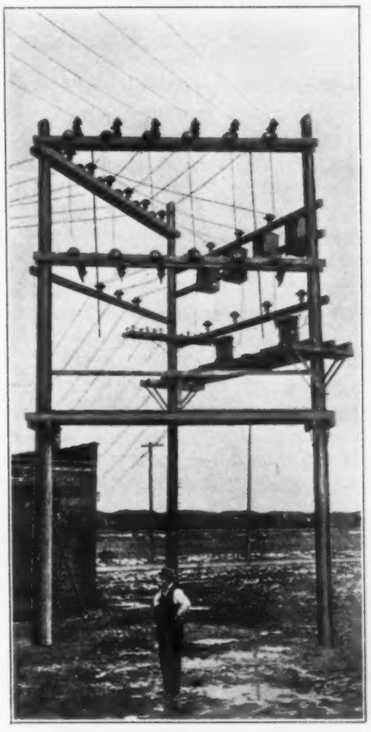


FIG. 2—11,000-VOLT SWITCHING TOWER WITH PLATFORM FOR OPERATOR

and by the fact that the three-pole disconnecting switches required flat construction. In the old type of construction the taps for the station were taken off from the main line by buck arms, but it was not considered desirable to repeat this construction as buck arms with their taps had been found to make a poor and dangerous job.

For pilot lamps standard 11,000/110-volt, 2.5-kva transformers were used, protected by Matthews fused switches. The tie switches were of the single-pole inverted type. They were so mounted that there remained plenty of clearance above the platform when the switches were open.

The accompanying sketch shows the relative location of the switches and transformers, and the picture presents some idea of the finished tower construction. From the platform shown, the operator can do all necessary switching in minimum time and with the greatest possible degree of personal saftey.

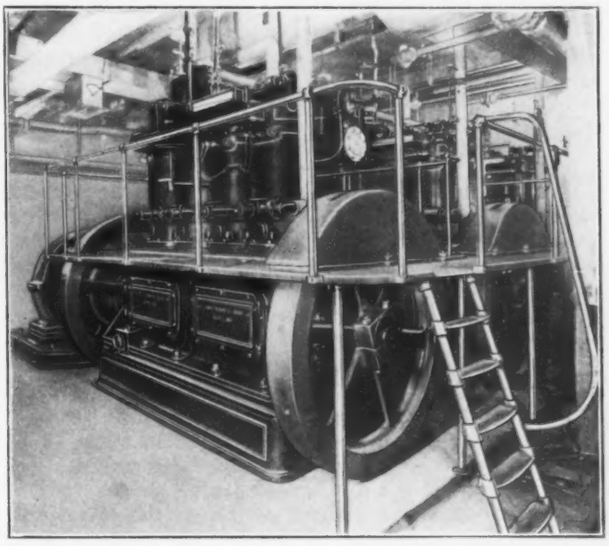
Inertia Effects

A crane hoist of which the motor was electrically braked had given all kinds of trouble. First, the brake wheels would break through their hubs; the operator reinforced them. Then the armature cores started to loosen on their shafts. This apparent weakness was strengthened by pressing the cores onto the shafts and securing them with two keys instead of one. Everything then went smoothly till the pinion end of the armature shaft twisted off at the filleted shoulder. A spare armature suffered the same fate. Then the operator sought help. The inspector ascertained that the crane gearing in the first place had been such that the electric brake had to be used to hold the hook load when the motor circuit was off and also to control the rate of lowering. The gearing was later changed to the worm-and-wheel type, in which the worm would hold the load and all the electric brake had to do was to stop the armature. This it was doing instantaneously, as nearly as the eye could judge. The result was that when the brake stopped one end of the armature shaft the whole core with its copper winding would tend to keep turning, and it was only a matter of the weakest part breaking. The weight by means of which the brake was applied when the main circuit was thrown off was decreased 75 per cent, whereupon all troubles ceased.

Combined Steam and Gas-Engine Plant for Hotel Service

The Fort Pitt Hotel, Pittsburgh, Pa., is equipped with a combination steam and gas-engine plant. The gas engines were installed in the fall of 1912 when an addition was made to the hotel. Prior to that time only steam was used. The mechanical equipment includes three 316-hp Heine boilers and three Roney stokers, two 250-hp Erie-Ball four-valve steam engines, three 100-hp Erie-Ball slide-valve steam engines and three 150-hp Bruce-Macbeth four-cylinder gas engines. All of the above engines are connected directly to Westinghouse 125-volt direct-current generators. There are also a 20-in. by 16-in. by 20-in. and a 16-in. by 10-in. by 20-in. Burnham steam pump, a 15-ton and a 30-ton Frick ice machine, a 48-hp air compressor and a four-sweeper steam vacuum cleaner.

A comparison of the fuel costs for the months of January and June, 1912, when steam was used exclusively, and those for the corresponding periods in 1913, when both steam-driven and gas-engine units were



THREE 150-HP GAS ENGINES DIRECTLY CONNECTED TO 125-VOLT GENERATORS

used, is given in the accompanying table. In 1912 there were 540 rooms and in 1913 approximately 700 rooms, representing an increase of 29.5 per cent. The cost of labor for 1913 was practically the same as that for 1912. The data for June and January are taken to give a comparison of both winter and summer operation. The cost of coal was $1.70 per ton delivered and

that of the gas approximately 20 cents per 1000 cu. ft.

At all times of the year enough steam equipment is run to heat the water by the exhaust steam and in cold weather to heat the building. In the summer the pumps and ice machines furnish sufficient exhaust steam to heat the water, and the three gas engines are run almost continuously during this time. In the winter sometimes two and sometimes only one gas engine is run. The refrigerating machines run practically continuously. The air compressor runs continuously twenty-four hours and the vacuum cleaner about twelve hours, daily. The kitchen steam consumption in January and June, 1912, averaged about 75 boiler hp and for the same time in 1913 about 100 boiler hp.

FUEL COST AND OUTPUT FOR TWO MONTHS OF 1912 AND 1913

	January, 1912	January, 1913	June, 1912	June, 1913
Kilowatt-hours delivered	133,660	149,380	106,220	125,480
Gallons water pumped	8,139,276	11,176,506	9,366,464	10,420,590
Coal consumed in tons	1,000	766	850	511
Cost	$1,733.81	$1,474.07	$1,328.01	$885.95
Gas cost	.....	157.80	.....	315.60
Oil cost	84.16	94.06	89.95	103.64
Total cost (coal, gas, oil)	$1,817.97	$1,725.93	$1,417.96	$1,305.19

From the figures in the table the total output for January and June, 1912, was 239,880 kw-hr. and for the same months in 1913, when the gas engines were used, 274,860 kw-hr., an increase of 34,980 kw-hr., or 15 per cent. The water pumped in January and June, 1912, was 17,505,740 gal. and for the same months in 1913 21,596,096 gal., an increase of 4,090,356 gal., or 36 per cent. The coal charges for January and June, 1912, were $3,061.82 and those for oil $174.11, making a total of $3,235.95, and for the same months in 1913 the coal charges were $2,360.02, gas $473.40, oil $197.70, making a total of $3,031.12, a decrease of $204.81, or 6.4 per cent. These figures show a reduction in fuel costs in spite of increased output and a greater hotel service.

Repulsion-Induction Motor Trouble

A repulsion-induction motor has, in addition to the main field winding, to which line voltage is applied in the same way as to the stator of any other induction motor, a compensating field winding wound upon the same poles. The rotor, which is a direct-current armature, may have no electrical connection with the main field winding. In its simplest form the motor has two sets of brushes. One set, called the "energy brushes," is short-circuited. It is this so-called "energy" circuit to which rotation is due. The other brushes are connected to the compensating field winding. One function of this compensating winding, energized by the rotor, is to limit the free speed of the motor, for the greater the speed the greater the rotor voltage and the stronger the compensating field. In variable-speed motors both of these circuits are opened, the terminals being brought outside of the motor and the circuits there completed through variable resistances contained in a controller.

An inspector was called in to find the trouble with each of two small motors, one of which ran too fast and the other of which would not run at all. Both installations were new. The motor that would not start had a broken grid in the resistor of the energy circuit, so that that circuit could not be energized until the controller was pushed well around toward the full-on position. On the motor that ran too fast at light load a brush was missing from one of the brush holders of the compensating circuit, so that the compensating circuit was inactive and could not, therefore, strengthen the field and limit the speed. Without the limiting influence of the compensating field, the motor free acts like a series direct-current motor.

Charging Lightning Arrester Causes Transformer Noises

In charging electrolytic lightning arresters a noise, between a hiss and a squeak, is heard on the transformers. What is the cause? C. O. R.

The noise is due to vibration, which is probably caused by the half-wave charging current taken by the lightning arrester. This current sets up a pulsating magnetic flux in the transformer core which tends to cause any loose laminations to vibrate in unison with it.

Radio-Telegraph Antenna

What are the advantages of the umbrella radio-telegraph antenna? D. T.

The umbrella aerial is preferred to the flat-top for some installations because it can be supported from a single mast and (in quenched-gap working) because its radiation damping is as a rule less than that of a flat-top antenna of equivalent capacity and height. The flat-top antenna in general can be erected more conveniently in restricted quarters and for a given maximum height has greater transmitting or receiving ability. The transmitting ability of an aerial is determined largely by its "effective height." This height is equal to the geometric height in the case of a flat-top or, in the instance of an umbrella, to the average height of the middle points of each rib wire.

Resistor for Shunting Series-Field Coils

How can the proper amount of shunt resistance to be connected across the series-field circuit of a compound generator be determined? F. P. S.

If the generator is already constructed and factory test data are not available, perhaps the simplest way to determine the amount of resistance to be shunted across the series-field circuit is by making trial tests with a water rheostat. Connect in series across the terminals of the series-field coils the rheostat and an ammeter, the maximum scale reading of which should not be much smaller than the rated full-load current of the generator unless some precaution is taken to protect the instrument. Operate the generator at no-load and adjust the shunt-field circuit resistance for no-load voltage; then load the generator to its rated current output or to the amount at which a definite voltage is desired and adjust the shunted water rheostat to give that particular voltage across the generator terminals. Record the current through the water rheostat when the right conditions are obtained, and then disconnect the entire temporary shunt circuit from the series-field coils and measure its resistance with the same current value. By employing the data thus obtained and using wire having a temperature coefficient close to that of the series-field conductors it will be possible to design a satisfactory shunt resistor. After the final connections are made between the shunt resistor and the series-field terminals, the resistor can be insulated by wrapping it with heavy cord.

Digest of Current Electrical Literature

Abstracts of Important Original Articles Appearing in the Periodical Electrical Press of the World

Generators, Motors and Transformers

Experimental Investigations of Field Distortion and Commutation in a Modern Dynamo.—A. MAUDUIT.—An account of a continuation of the author's former researches into the phenomena of commutation. He had formerly studied a comparatively simple Rechniewski dynamo, and later three more complex designs of Oerlikon, Thury-Schneider and Gramme. He now takes up the case of a modern multipolar dynamo with equipotential connections and auxiliary commutation poles. A large number of oscillograms obtained with a Blondel oscillograph of latest design show very clearly the part which saturation plays in the distortion of the field under the brushes, the operation of the interpoles and all phenomena of commutation. Further experiments with alternating currents, combined with oscillographic tests, permit the author to state precisely the criterion of good commutation proposed by him in his former papers, and to apply it to a modern dynamo.—*La Revue Elec.*, April 3, 1914.

Eddy-Current Losses in Sheet Steel.—J. D. BALL AND W. E. RUDER.—It has been assumed for some time that the eddy-current losses in various magnetized materials vary inversely with the specific resistance. A number of observations have shown, however, that such is not always the case. For instance, certain silicon steels having five times the resistivity of common iron have been found to give only half as much eddy-current loss as the iron, and also certain heat treatments, which do not materially alter the resistivity, increase the eddy-current losses. It is also shown that the eddy currents increase rapidly with grain size up to a point where the grains can easily be seen with the naked eye. This article gives the results of several tests which have been made in an investigation of the factors influencing eddy-current loss. In addition it points out the unsatisfactory state of knowledge on the subject at the present time.—*Gen. Elec. Rev.*, May, 1914.

Lamps and Lighting

Direct-Current Conversion for Railway Lighting.—P. AMSLER.—The author has formerly described a system for use on high-tension direct-current traction lines for transforming the high-tension direct current to low-tension direct current for lighting, heating, driving ventilators, etc. The arrangement is shown in Fig. 1. *A* is the trolley wire with an emf of 1200 volts, *B* is a series resistor, *C* a direct-current motor coupled to a low-tension direct-current generator *D*. *E* is an auxiliary winding, *F* a series winding, *G* a counter-compound winding, *H* excitation winding, *I* is the lighting generator with the auxiliary pole winding *H*, *K* being the compound winding, *L* the shunt winding and *M* the lamps. It will be seen that the high-tension machine in the converter set is separately excited by the low-tension current of the low-tension circuit. The electric road from Biasca to Acquarossa in Tessin is equipped with three such groups for transforming the trolley voltage of 1200 to the lamp voltage of 115. On the Wendelstein road in Bavaria such machine sets have been in operation for two years on a trolley voltage of from 1500 to 1800. The same machines are now being used on all 1200-volt direct-current roads of Brown, Boveri & Company. In the former installations two direct-current machines, each of 1.25 kw, of standard construction were used rigidly coupled together, but this makes the set rather heavy. For this reason a new machine type has been designed which is 30 per cent lighter, though the output rating is 2 kw. These machines have a constant transformation ratio independent of the load on the trolley wire. The voltage drop in the trolley wire, therefore, causes a proportional drop on the secondary side. If this is considered to be a disadvantage, constant voltage may easily be obtained by means of an automatic rapid regulator such as used by Brown, Boveri & Company in general for train lighting. Fig. 2 shows the connections of such a machine set with an automatic regulator. This system is used on the Bern-Oberland roads. The high-tension motor *M* is coupled with a low-tension generator *G* and a ventilator. While the high tension varies between 1300 volts and 1700 volts, the speed of the set and the voltage of the dynamo on the low-tension side are automatically kept constant by means of the voltage regulator. In this way the ventilator always supplies the same amount of air and the voltage at the lamps is independent of the fluctuation of the voltage of the trolley wire. The arrangement of Fig. 2 is simi-

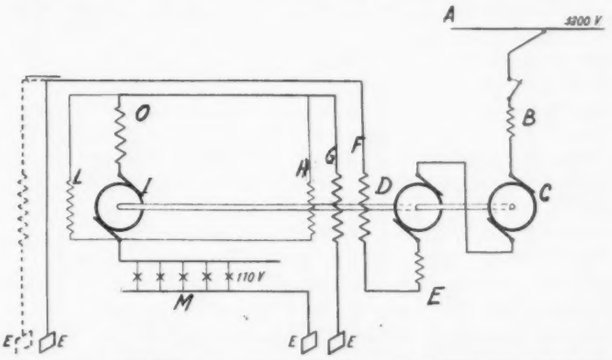


FIG. 1—METHOD OF OBTAINING LOW-TENSION ENERGY FROM HIGH-VOLTAGE TRACTION CIRCUIT

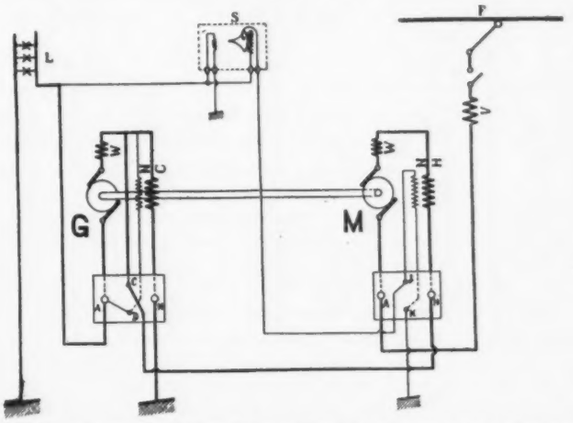


FIG. 2—VOLTAGE REGULATION FOR TRACTION-CAR LIGHTING

lar to that of Fig. 1. The chief advantage is the use of an automatic voltage regulator which regulates the voltage of the generator. Moreover, the counter-compound winding of the motor is omitted since its function is fulfilled by the voltage regulator. There are no magnetic field coils in the high-tension line. Only the armature of the motor is supplied with high-tension current and its winding is, therefore, very strongly insulated with a mica preparation.—*Elek. Zeit.*, April 16, 1914.

Generation, Transmission and Distribution

French Power Plant.—J. DE SOUCY.—La Société Pyrénéenne d'Energie Electrique is a French power company greatly favored by the availability of large water-powers, but embarrassed by their location in a district of little industrial development. The author gives a concise history of the development of the company and describes especially the methods employed in building up a load which has as far as possible a uniform load curve.—*La Lumière Elec.*, April 11, 1914.

Phase Compensation.—G. H. EARDLEY-WILMOTT.—An illustrated article in which the different kinds of plant available for phase compensation are considered, such plant being classed as (1) that which may improve the power-factor of the system as a whole and (2) that which is applied to individual motors. The over-excited synchronous motor is first considered, the effects being illustrated graphically and by a specific instance. Reference is then made to condensers, and lastly a case is taken where a rotary phase-advancer is used. It is pointed out that the type of plant to be adopted must depend on the circumstances of each case, it being impossible to lay down any general rule.—London *Electrician*, April 17, 1914.

Ship's Steering Gear.—A note on a recent British patent (No. 1505, 1913) of the British Thomson-Houston Company and the General Electric Company of this country. The motor controller consists of two independent drum controllers connected by differential gearing, the intermediate element of which can be worked by the steering wheel to set one drum to drive the motor working the rudder, while this motion rotates the other drum so that through the gearing the first drum is brought to its original or "off" position. The motor is fed through a motor-generator whose generator-field current is varied by a rheostat controlled by the motor-generator shaft through a clutch and holding-off magnet.—London *Elec. Eng'ing*, April 16, 1914.

Gold Dredging.—W. H. GARDNER AND W. M. SHEPARD.—An illustrated article on the construction, equipment and operation of the latest and largest electrically operated gold dredge, Yuba No. 14.—*Gen. Elec. Rev.*, May, 1914.

Traction

Heating Trolley Cars.—OSKAR STEGEMANN.—A paper read before the Electrical Society of Berlin. The author describes different systems for heating trolley cars. Heating by means of the starting and stopping resistors is cheap but very poor. To get a reliable system special heating resistors must be provided. For this purpose carbon lamps or resistor wires have been used. The author describes in detail a new system in which the resistor consists of a metallic tube made from nickel-steel ribbon bound in helix form so as to form a tube. These resistor tubes are arranged vertically so as to produce a movement of the hot air upward in the tube. With this system it is possible to produce the desired temperature within a few minutes. A heating furnace of this kind of 500 watts weighs 4.5 kg (9.9 lb.), and fifteen such furnaces are used in one car on the Berlin tramway system.—*Elek. Zeit.*, April 9, 1914.

Automobiles.—T. CLARKSON.—A paper read before the (British) Institution of Civil Engineers on "some recent developments in commercial motor vehicles," dealing with steam, gasoline and electric automobiles.—London *Electrician*, April 17, 1914.

Installations, Systems and Appliances

Berlin Central Station.—EMIL SCHIFF.—An illustrated article on the development of the Berlin Electricity Works and a discussion of the best policy to be adopted by the city. The question is now before the municipality of Berlin, either to take the plant over for municipal operation or to renew the concession to the Berlin Electricity Works under new conditions. At present the city of Berlin gets about one-half of the total net income of the plant. The technical development of the electricity works has been steady, as has also been the increase in the net income. This is shown by the form of the curves extending over the last twenty years. On the other hand, the dividends paid have fluctuated from 1890 to 1912 between 7.75 per cent as a minimum and 13.5 per cent as a maximum and were 12 per cent in 1911. The stock quotations have been subject to still greater fluctuations. The question of erecting a very large generating station in the Bitterfeld lignite district, with a transmission line to Berlin, is considered. The author thinks that in Germany better economic results have been obtained with municipal stations than with privately owned stations. He is in favor of the project that the city of Berlin should take over the electricity works. If, however, the city should decide in favor of giving a new concession, the prospects are that in the future there would be a combined municipal and privately owned management. But the author thinks that in this case the old management, having an experience of many years, would be practically in control.—*Elek. Zeit.*, April, 16, 1914.

Central-Station Development in Germany.—THIERBACH.—The author calls attention to the following results for the 1648 German central stations for which statistical data are available. The aggregate sum of their ratings is 2,100,000 kw. One hundred and three stations have a rating of more than 5000 kw each and the aggregate rating of these 103 stations is 1,560,000 kw. The rating of all stations with a smaller rating than 5000 kw each is, therefore, 540,000 kw. As a matter of fact, in the 103 large stations only 800,000 kw is usefully employed, so that 760,000 kw is useless. This is more than the rating of all the stations with less than 5000-kw rating, and the author concludes that the machines and storage batteries installed in the 103 largest stations would have been entirely sufficient to supply all the energy needed in the whole of Germany. The author shows that the situation has not improved in late years, and that on the contrary during the last ten years the number of very small stations of less than 500 kw each has increased enormously. This he considers to be a very great economic waste. His article is a plea for the creation of a central bureau which should prevent the foolish erection of small central stations and should take into consideration the supply of energy all over Germany in accordance with a uniform systematic plan.—*Elek. Zeit.*, April 16, 1914.

The Compulsory Purchase of British Electric Central Stations.—The first of a series of articles in which the harmful effect of the compulsory purchase of electricity undertakings by municipalities is considered, more particularly in regard to London electricity supply. The present article deals with the relation of private enterprise to progress as shown by the various public utilities. In a second article the reward of private enterprise will be discussed, and it will be pointed out that this reward, as measured by dividends, is by no means

as large as is often supposed. In a third article the fallacy of municipal trading is to be discussed, emphasis being laid on the danger of permitting the government or a municipality to have a monopoly, such danger being greater than in private enterprise. This danger is well exemplified in the history of the National Telephone Company. A fourth article is to be a brief history of the London electricity supply companies. In a fifth article the effect of compulsory purchase looming in the near future is to be shown to cause necessarily a less active policy than would otherwise be the case, besides increasing difficulty in expansion. In a sixth article the effect of compulsory purchase in the near future is to be shown to cause a restriction of capital expenditure, illustrated by reference to the last few years of the existence of the National Telephone Company. It is shown that working under municipal control cannot be so efficient as private enterprise. Various alternatives are considered. These are the "mixed" type of undertaking, as found in Germany; the control of dividends, as in the case of gas companies, and the working under control of an independent authority. This last is found to be extremely successful in America, and is suggested as a solution of the present difficulty in London electricity supply.—London *Electrician*, April 17, 1914.

Auto-Transformers.—LEE HAGOOD.—On account of cheapness the auto-transformer is attractive for energy transmission. Although some are in successful operation, considerable care should be observed before adding an auto-transformer to a system. A contract was made with Company "A" for the purchase of sixty-cycle, 22,000-volt energy by Company "B." Available for supplying this power was a 16,000-volt, sixty-cycle system and a twenty-five-cycle system. A frequency-changer set was installed arranged for 2300 volts on the sixty-cycle side. It was therefore necessary to furnish apparatus to step the voltage from 2300 volts to 22,000 volts and from 16,000 volts to 22,000 volts. To meet the two conditions of voltage transformation a transformer was installed having a delta connection from 2300 volts to 22,000 volts and the high-tension winding waz connected as an auto-transformer for 16,000 volts to 22,000 volts. The connections are illustrated in Fig. 3. In view of the fact that both systems are isolated, the auto-transformer neutral was not grounded, since grounding would involve changing all the two-pole relays on the automatic oil switches to three-pole relays. This would also have involved the addition of another series transformer for each automatic switch. The transformer in question was a 3600-kva set made up of three single-phase units. Trouble arose when an attempt was made to supply energy from the 16,000-volt system with the 2300-volt delta connection open. Immediately serious telephone disturbances arose. By closing up the 2300-volt delta winding the disturbance was brought to an end. The next trouble arose some time later when Company "B" experienced a "ground" which raised the dynamic voltage from 16,000 volts to 19,000 volts on the Company "A" side. Simultaneously high frequency was transmitted through the auto-transformer due to the arc at the ground on the Company "B" side. This caused the horn-gaps of the 16,000-volt lightning arresters to arc, and thereupon the lightning arresters were destroyed. If a transformer with two secondary windings had been selected in the first place, it would have been only slightly more expensive than the present auto-transformer combination and would not have been exposed to any of these troubles. While it might appear that grounding an auto-transformer would solve all serious difficulties, yet the author shows that this would have presented several distinct disadvantages.—*Gen. Elec. Rev.*, May, 1914.

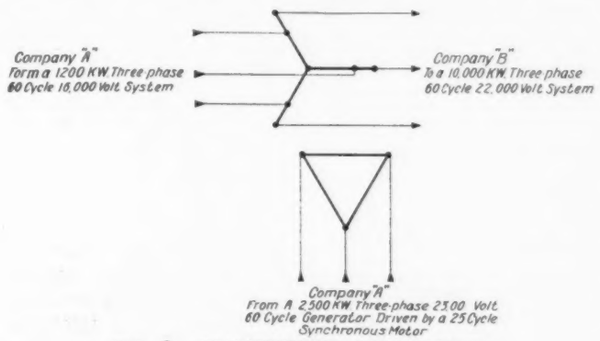

Company "A"
Form a 1200 KW Three phase
60 Cycle 16,000 Volt System
Company "B"
To a 10,000 KW Three phase
60 Cycle 22,000 Volt System
Company "A"
From A 2500 KW Three-phase 2300 Volt
60 Cycle Generator Driven by a 25 Cycle
Synchronous Motor

FIG. 3—TRANSFORMER CONNECTIONS

Wires, Wiring and Conduits

Current Density of Transmission Lines.—NILS FORRSBLAD.—An article illustrated by diagrams and tables in which the author shows how the most economical current density of an overhead-transmission line can be calculated from the price of the energy or read directly from curves.—*Elek. Zeit.*, April 16, 1914.

Purifying Copper.—A note on a recent British patent (No. 6286, 1913) of the British Thomson-Houston Company and the General Electric Company of this country. Copper of a high degree of purity is obtained by melting the copper above a mixture of inert material and boric anhydride. The temperature is kept at about 1300 deg. C., while the boric anhydride is kept beneath by the inert material and the mass is stirred until the boric anhydride rises to the surface. The process may also be applied to silver, gold, etc.—London *Elec. Eng'ing*, April 16, 1914.

Electrophysics and Magnetism

Lecher Oscillator.—F. C. BLAKE AND CHARLES SHEARD.—A third paper on the vibrations of a Lecher system using a Lecher oscillator. In their last paper they stated that when the Lecher system was in exact tune with the oscillator and receiver circuits Abraham's theory ought to apply, provided the various harmonics were damped out proportionately. The present paper gives the results of experiments in which they tried this. The results are given in diagrams and tables. Decreasing the couplings at both ends of the Lecher wires does not affect appreciably the degree of harmony of the tones. Increasing the coupling at the oscillator end only does decrease the harmony of the tones. An increase in the end capacity decreases the harmony of the several tones. It would seem that three conditions need to be fulfilled if the various tones are to be strictly harmonic, namely, (1) the distance between the Lecher wires must approach zero; (2) the end capacity must approach zero, and (3) the coupling must be loose at both ends of the Lecher system.—*Phys. Review*, March, 1914.

Units, Measurements and Instruments

Multiple Recorders.—A note on a recent British patent (No. 5734, 1913) of the British Thomson-Houston Company and the Allgemeine Elektricitäts Gesellschaft. Different markings are produced by the use of a paper soaked in an electrolyte and different electrodes, or by different current strengths. One or both sides of the record sheet may be used. Suitable electrolytes are potassium ferro-cyanide or iodide; for example, paper soaked in the first will give a red, blue or green line with a positive electrode of copper, iron or steel.—London *Elec. Eng'ing*, April 9, 1914.

Thermal Emf at the Junction of Metals and Metallic Oxides.—S. L. BROWN.—An abstract of an American Physical Society paper. Considerable electromotive

force is generated when a cold wire is brought in contact with a similar or dissimilar hot wire. If two iron wires are fastened to the terminals of a galvanometer, one wire is heated in a flame, and the heated portion is touched with the cool wire, the emf is many times sufficient to throw the galvanometer deflection off the scale. If two similar wires are left in the flame, the emf will reduce to zero or nearly zero, and if they are dissimilar the emf force will reduce to the value that is characteristic of the two metals at the particular temperature. These large emfs were found to be due to the oxides which formed on the heated metals. The results of experiments with several couples are given. The temperature of the oxide at the point of contact with the cool wire is much lower than the temperature of the oxide at the point of contact with the hot wire, and consequently a metal, metal-oxide thermocouple is formed. These results emphasize the necessity of close contact between the metals of any thermocouple since a very small difference between the temperatures of the wires would produce erroneous results if an oxide separated the wires. There also seems to be sufficient reason for discarding the method that is sometimes used to test thermocouple wires for homogeneity. This method is to bring two wires in contact in a flame, and by moving from point to point along one wire nonhomogeneity would result in a thermo-emf if the wires were of the same material or a change in the emf if the wires were of different materials. A small difference between the temperatures of the wires and an oxide between them would produce emfs much larger and much more variable than the emf force due to nonhomogeneity.—*Phys. Review*, March, 1914.

Telegraphy, Telephony and Signals

Electric Transmission of Pictures.—Artur Korn.—The author gives an illustrated review of the present status of picture telegraphy by means of the selenium-cell method and the telautograph method. He then describes a recent improvement in the form of a relay which permits a considerable increase of the weak currents obtained by transmission with the selenium method. There are two types of relays. In one type if i is the amplitude of the current received in the receiver at any moment, then the relay gives an amplitude ai, where a is a constant greater than unity so that the amplitude given by the relay is always proportional to the current received. The microphone relays and the Lieben relay are of this type. The second type of relay is what the author calls a step relay. For instance, if the current received varies between 0 and 1 milliampere, he divides this range into ten steps. The first step is from 0 to 0.05 milliampere, the second from 0.05 to 0.15, and so on, the ninth from 0.75 to 0.85, and the tenth from 0.85 milliampere to 1 milliampere. The author's relay changes any current of the tenth step into current of the intensity of $9a$ milliamperes, any current of the ninth step into $8a$ milliamperes and any current from the second step into a milliamperes, while the currents in the first step are not affected. a is greater than 0.1. The operation of his relay is based on the property of weak high-frequency currents (Tesla currents) to light arcs instantaneously. By means of very sensitive telephone instruments Tesla currents are directed to air-gaps, the terminals of which are shunted by suitable direct-current or alternating-current voltages, so that heavy-current arcs are started by means of the Tesla currents. Some further applications of this new step relay are described.—*Elek. Zeit.*, April 16, 1914.

Propagation of Electromagnetic Waves in Wireless Telegraphy.—George R. Dean.—The first part of a theory of propagation of electromagnetic waves in wireless telegraphy. In this part the author discusses the simple Hertz element and the electric doublet, dealing with the magnetic intensity at points near the origin, Hertz's solution of the vibrating electric doublet and the determination of the constants in the solution, the components of electric and magnetic intensity and their values on the origin and at infinity, the components of the field, the lines of electric induction, and the effect of a third harmonic.—London *Electrician*, April 10, 1914.

Book Review

Formulæ and Tables for the Calculation of Alternating-Current Problems. By Louis Cohen. New York: McGraw-Hill Book Company, Inc. 281 pages, illus. Price, $3.

In the study of alternating currents, and in the solution of the more complicated problems which the engineer must necessarily encounter the moment he departs from the well-worn ruts of common practice to enter the newer or less familiar fields of investigation, a sound knowledge of mathematics is almost essential. It is, however, not within the scope of the book before us to instruct the reader in the principles of mathematics. The knowledge requisite to apply the formulas and tables intelligently is assumed. The work is, in fact, of the nature of a compilation, all sources of information being drawn from freely in order that the most accurate and useful formulas may easily be found in connection with the particular subject to which they are applicable. Apart from the fact that some of the formulas and methods of working are due to the author, he lays no claim to having produced an original work; yet it must not be supposed that any writer, however great his mathematical knowledge, is capable of collecting and presenting the material in such a manner as to form a really valuable addition to the literature of alternating currents. The author has taken great pains to attain accuracy and completeness, and he is to be congratulated on the result of his labors, which cannot fail to be welcomed by scientists and engineers, who will find here collected and admirably presented such information as they would ordinarily have to seek in various more or less accessible scientific publications. The plan of applying many of the formulas to the working out of numerical examples adds greatly to the usefulness of the book. The matter is arranged systematically and presented in the following order: Resistance and eddy-current losses; inductance; capacity; alternating-current circuits; transient phenomena; distributed inductance and capacity. In the final chapter a number of useful mathematical formulas and tables (including exponential and hyperbolic functions) are collected for easy reference. The long-distance overhead transmission line receives its due share of attention, and several formulas are given both for concentrated and distributed capacities. The engineer engaged on the practical design of transmission lines may, if he desires, use the more accurate formulas applicable to the case of distributed capacity; but he is not likely to do so when simpler formulas are available. He knows that the actual wave-form rarely, if ever, adapts itself to the mathematical conception of what it ought to be, and for that reason he is not inclined to waste time on mathematical niceties based on false premises. The book, however, is not primarily intended for the use of the practical engineer. It deals with exact methods and solutions, and the engineer is at liberty to use discrimination in arriving at the approximations which will generally satisfy his needs.

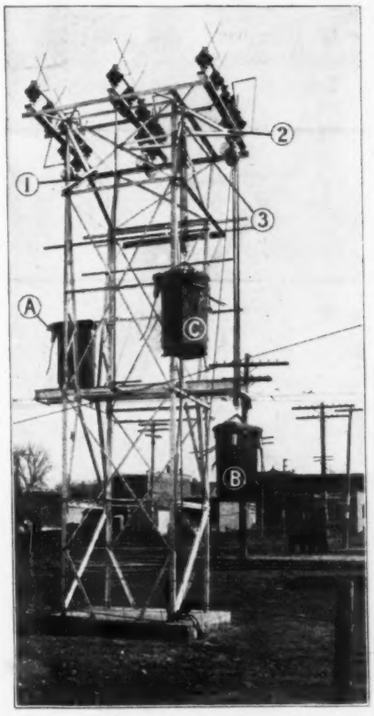
New Apparatus and Appliances

An Illustrated Descriptive Record of Recently Developed Manufactured Products of Interest to Electrical Readers

Transformers on Steel-Tower Substations

One of the problems confronting the central-station managers using steel-tower outdoor high-tension substations is the economical handling of transformers. However well a station may be designed to control and protect transformers, it falls short of commercial requirements if the method of handling the transformers is difficult. An outdoor substation designed to meet conditions encountered in practice is shown in the accompanying illustration. This station is equipped with a transformer platform provided with a transfer truck, which can travel the full length of the I-beam supports. Near the top of the front corner posts are pivoted single-jib and double-jib cranes, indicated as 1, 2 and 3. These jib cranes, which have a large radius of action, are provided with steel U-bolts to take the tackle hooks.

Assuming that the middle transformer B has failed and must be removed, the end transformer C is first raised by means of the No. 3 jib crane; it is then swung around out of the way and left hanging on the tackle. The transfer truck with the middle transformer B is next rolled to the end of the platform, the transformer being raised with jib No. 2, then swung around and



HIGH-TENSION OUTDOOR SUBSTATION

lowered to the ground. To restore service, transformer C is swung around and lowered to the platform, the station now operating in open delta until the defective transformer can be repaired. By this combination of transformer truck and jib cranes, it is said that transformers of any weight up to 4000 lb. can be handled easily.

These steel-tower outdoor substations are manufactured by the Delta-Star Electric Company, Chicago, Ill.

Ventilated Reflectors Designed for Incandescent Lamps

The reflectors and diffusing units shown in the accompanying illustrations have been designed for use with high-efficiency 750-watt and 1000-watt tungsten lamps. The semi-indirect unit shown in Fig. 1 consists

FIG. 1—SEMI-INDIRECT UNIT

FIG. 2—DIFFUSING UNIT

of a Druid-glass outer envelope within which is suspended a prismatic glass reflector which directs the light up toward the ceiling. Air passes downward between the reflector and envelope and upward through the center of the reflector between the lamp and the reflector. The diffusing unit shown in Fig. 2 consists of an outer envelope of dense opal glass and a bowl at the bottom of crystal roughed glass. Air enters from below the lower band of the fixture and escapes through the hood

FIG. 3—SHALLOW-BOWL REFLECTOR

above. Shallow-bowled and deep-bowled enameled-steel reflectors have been designed for use on platforms and in shops, yards, etc. The screening angle of the shallow-bowl unit shown in Fig. 3 is 85 deg. These reflectors and diffusing units have been developed at the Holophane Works of the General Electric Company, Cleveland, Ohio.

Electric Coffee Urn and Teakettle

The electric spray coffee urn and tilting teakettle shown herewith are being placed on the market by the Simplex Electric Heating Company, Cambridge, Mass. The colonial type of silvercraft is used in the design of the urn. Spraying with the latter begins in two minutes when starting with warm water and in from four to five minutes when starting with cold water. The stove is provided with a "lock-on" device which insures good heating contact and conservation of heat. It is equipped with a three-heat switch. The urn can be removed and the stove used for toasting or other light cooking purposes when desired. The urn is equipped with a 6-ft. silk cord, a lamp-socket attachment and a quick-detachable connector. The stove is rated at 500 watts.

ELECTRIC SPRAY URN

ELECTRIC TILTING TEAKETTLE

The tilting teakettle is made of solid copper heavily nickel-plated and double-tin-lined. The stand is so arranged that the kettle may be easily tipped for pouring and at the same time the heat will not be interfered with. The kettle can be removed from the stand. Water can be boiled in a very short time, because the heater is a part of the bottom of the kettle. An automatic safety device is provided to prevent damage to the heater in case the kettle becomes dry. The cord can be disconnected from the kettle quickly by means of a detachable connector. The kettle is either nickel-plated or has a copper finish.

Outdoor Fixtures for Nitrogen-Filled Tungsten Lamps

The fixtures shown in the accompanying illustrations have been designed for outdoor use with high-efficiency tungsten lamps. In Fig. 1 is shown a fixture of the suspension or pendent type, and in Fig. 2 one of the bracket type. The large porcelain casings make an extra insulator for either multiple or series circuits unnecessary. These fixtures are equipped with a one-piece series socket which can be adjusted up and down so that the same fixture and reflector may be used with lamps of different sizes. The provision for moving the socket up and down makes it possible to place the lamp in the proper position in relation to the reflector and allow the use of a one-piece reflector, which is rigidly attached to the casing. The bowl-shaped reflectors used with these fixtures are provided with either a porcelain-enamel reflecting surface or one made of a material called "Ky-Ce Lain." The span type of reflector is equipped with a self-locking cable grip to prevent the fixture from sliding along the rope. These fixtures are being manufactured by the Line Material Company, South Milwaukee, Wis.

FIG. 1—SUSPENSION-TYPE FIXTURE

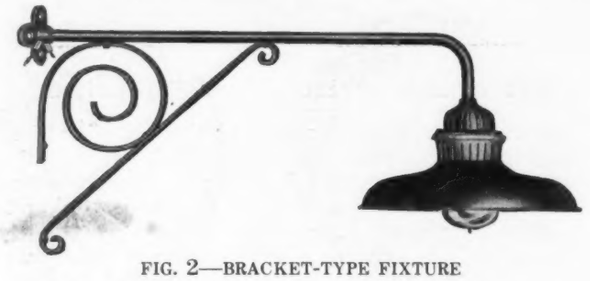


FIG. 2—BRACKET-TYPE FIXTURE

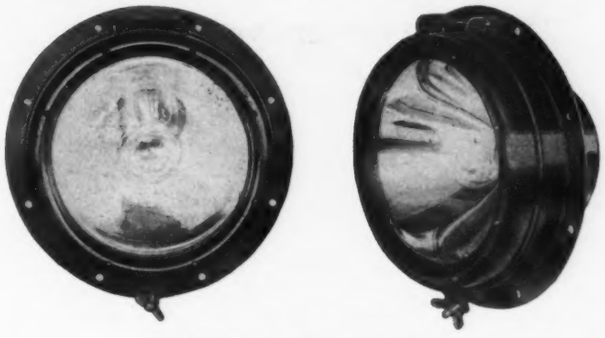
Luminous-Bowl Indirect-Lighting Fixture

The indirect-lighting fixture illustrated herewith has been designed for use with either a 100-watt or a 150-watt tungsten lamp. By means of a one-piece silvered-glass reflector the light from the lamp is directed to the ceiling at the proper angle. The small amount of light which comes through the opening in the bottom of the reflector is redirected by an opal-glass diffuser so as to illuminate the glass bowl evenly and softly for decorative effects. No useful light reaches the working plane directly through the glass bowl. With the exception of a narrow metal band the bowl is made entirely of glass. This fixture is being placed on the market by the National X-Ray Reflector Company, Chicago, Ill.

INDIRECT-LIGHTING FIXTURE

Headlamps for Electric-Railway Service

Two lamps for electric-railway cars are being placed on the market by the Esterline Company, Indianapolis, Ind. One unit is designed to fit in a recess in the dash of the car and the other for mounting on the front of the dash. The lamp bodies and fronts are made entirely

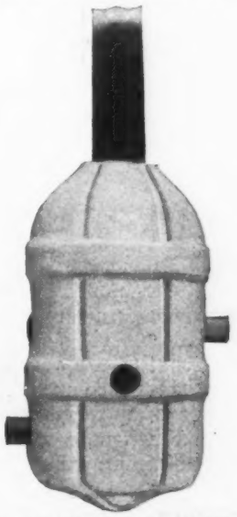


ELECTRIC-RAILWAY HEADLAMPS

of pressed steel. A metal ring which holds the reflector in place also clamps a heavy gasket over which the front or door presses. The hinges and latches are designed so as to have no projecting parts which are likely to catch wires or ropes. Electrically welded joints and fastenings are used instead of screws or rivets. The lamps are ventilated in such a manner as not to admit dust or water. After assembling, the lamp bodies receive several coats of baked enamel inside and out. The front glass is extra heavy and is held in place by spring clips which permit of expansion and contraction without cracking the glass. These lamps are equipped with "Golden Glow" reflectors made by the above company.

Two-Circuit Porcelain Pendent Switch

A two-circuit push-button porcelain switch is being made by the Cutler-Hammer Manufacturing Company, Milwaukee, Wis. This switch is designed to replace a larger switch of the same type equipped with



TWO-CIRCUIT ALL-PORCELAIN PENDENT SWITCH

a brass cap put out by the same company. The switch is used to control two circuits. Control is accordingly centralized and, especially in the case of large chandeliers or clusters, provides a convenient means for controlling the lamps in two groups from one switch. A simple mechanism is used and the operation is positive and quick. The three terminal screws are placed at the top of the switch and the casing halves can be separated by the removal of only one screw. This switch has been approved by the Underwriters' Laboratories and is rated at 6 amp for 125 volts and 3 amp for 250 volts.

Tungsten-Lamp Fixtures

The fixtures illustrated herewith are designed for use with tungsten lamps. In Fig. 1 is shown a shallow-bowl reflector with a surmounting hood of enameled steel. The fixture shown in Fig. 2 is equipped with a 12-in. by 8-in. alabaster outer globe. An oxidized-

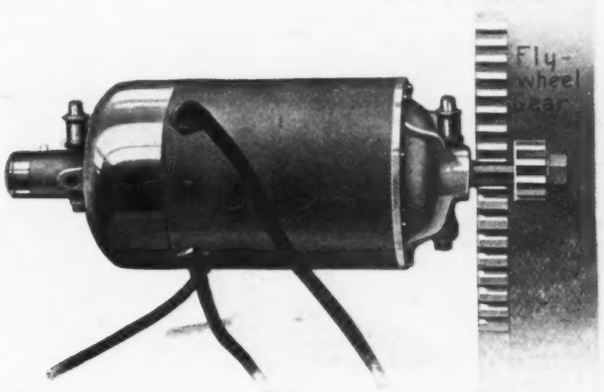
FIG. 1—SHALLOW - BOWL FIXTURE

FIG. 2—GLOBE FIXTURE

copper holder and a hood finished in black are used for outdoor service and a brushed-brass holder and hood for indoor service. The fixtures described are being placed on the market by the Benjamin Electric Manufacturing Company, Chicago, Ill.

Electric Starter for Automobiles and Motorboats

A 6-volt starting motor for use with internal-combustion engines employed in the operation of motor vehicles and boats is being placed on the market by the Rushmore Dynamo Works, Plainfield, N. J. The machine weighs about 30 lb. complete. The armature pinion engages directly with a gear upon the engine flywheel. As soon as the engine picks up, the pinion

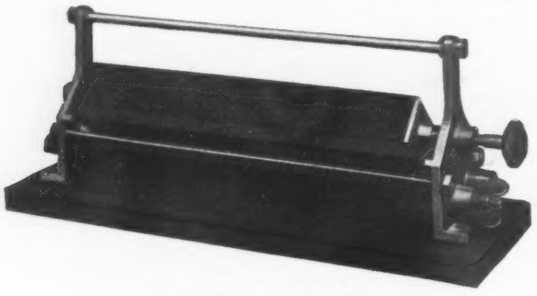


6-VOLT STARTING MOTOR FOR AUTOMOBILES AND MOTOR-BOATS

automatically slips out of mesh. The motor is of the ironclad type, series wound, with four poles and four brushes. Under normal conditions this starting motor, it is said, delivers to the flywheel rim nearly 75 per cent of all the energy received from the battery.

Compression Carbon Rheostat

A compression carbon rheostat for use in calibrating electrical instruments, testing batteries, photometric work, etc., is being placed on the market by James G. Biddle, 1211 Arch Street, Philadelphia, Pa. This rheostat contains ninety carbon plates ⅛ in. thick and 1.5

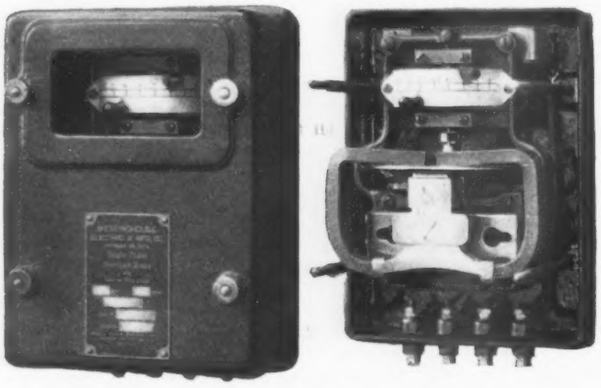


CARBON RHEOSTAT

in. square, which are mounted in a V-shaped trough made of asbestos wood. The end supports are bolted to a heavy asbestos-wood base, 15 in. by 5 in. by 0.5 in. in size, and are also held in place by rods which are insulated from the end supports by mica. A screw, operated by a hand-wheel, serves to vary the amount of pressure on the carbon blocks. Special brass plates with terminals are provided with each rheostat. These plates can be inserted between the carbon blocks, and the rheostat can accordingly be sectionalized to increase its range. The resistance can be varied uniformly between 0.1 ohm and 8 ohms according to the degree of pressure applied. For constant service the rheostat can safely take 200 watts, and momentarily, the manufacturer claims, it can take 500 watts or even 1000 watts without injury. The height of this device over all is 6 in., and the weight is approximately 8 lb.

Inverse-Time-Element Relays

Alternating-current relays designed for inverse-time-limit service have been developed by the Westinghouse Electric & Manufacturing Company, Pittsburgh, Pa. The relays are of three different types. One relay embodies the overload and reverse-power characteristics



FIGS. 1 AND 2—OVERLOAD RELAY, COVERED AND UNCOVERED

combined, another operates only when there is an overload, and the other when the power is reversed. The latter two relays are designed to work either instantaneously or at certain adjustable time limits.

The contacts of the overload-and-reverse-power relay are closed by an induction-type alternating-current instrument in which are combined the functions of ammeter and wattmeter. The relay is operated by means of a transformer with a pressure of 100 volts and a current of 5 amp at the secondary. The contacts close a direct-current tripping circuit. The maximum time-setting of the inverse time element is about ten seconds and that of the minimum about one second. With the minimum setting the tripping action is instantaneous for heavy loads. Three adjustments are provided, one for regulating the ratio of the reverse to the overload tripping current, another for regulating the absolute values of these quantities, and the third as above described for regulating the value of the time element. The relays can be adjusted to operate at from 6 amp to 14 amp in normal direction and from 0 amp to 4 amp with reversed power and normal voltage.

The plain overload relays are similar in principle to the combined overload and reversed-power relays, but the voltage connection is omitted. The instrument therefore acts as an induction ammeter. The minimum current at minimum time-setting for this relay can be adjusted from 3 amp to 5 amp and at a maximum time-setting for from 3 amp to 8 amp. A torque compensator is used as an auxiliary to this overload relay.

The relay for reverse power only is a combination of the overload-and-reverse-power-relay movement with a selective wattmeter element which keeps the trip circuit

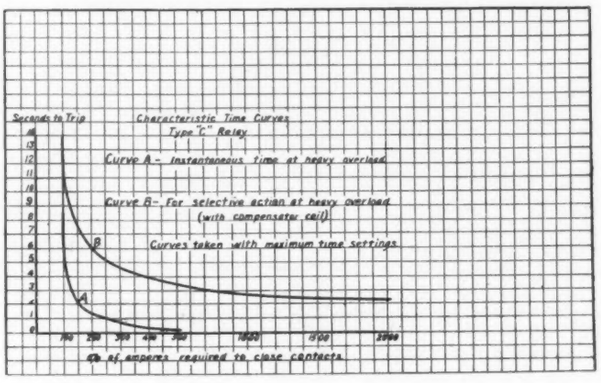

Seconds to Trip
Characteristic Time Curves
Type "C" Relay
Curve A - Instantaneous time at heavy overload
Curve B - For selective action at heavy overload
(with compensator coil)
Curves taken with maximum time settings
B
A
No. of amperes required to close contacts

FIG. 3—CURVE SHOWING EFFECT OF TORQUE COMPENSATOR ON THE TIME-ELEMENT CHARACTERISTICS

open for normal power requirements. This characteristic removes the overload feature of the main relay and allows the instrument to close the circuit only on reversed power. The time-element characteristics of the reverse-power relays are the same as those of the plain overload relays, and the same adjustments are provided.

A torque compensator for modifying the time-element characteristics of an alternating-current overload relay has been developed by the company. This device is said to reduce the torque of the relay at heavy overloads without decreasing it at light loads. The time-element of the relay is thus increased at overloads and the effect is proportional to the overload. An example of the effect of the torque compensator on the time-element characteristic of a relay is shown in the accompanying curves. When used with the torque compensator a definite minimum time element at heavy loads is obtained as shown in curve B.

This torque compensator consists essentially of a small auto-transformer connected between the relay and the series transformer on the line. It is so designed that at a certain value of current the core of the compensator becomes saturated and any further rise in current results in an increasing impedance drop so that the current in the relay circuit does not increase in proportion to the current in the line.

Jobber, Dealer and Contractor

Denver to License Electrical Contractors

An ordinance has been passed by the city commissioners of Denver creating a board of electrical examiners. This board is to consist of three members, the city electrician being, ex officio, chairman. It will also include one electrical contractor and one journeyman electrician. These three men shall have the power and authority to examine every person engaged in the electrical business, whether employer or employee, helpers excepted. After the person passes the examination the board will issue a certificate of qualification upon the payment of 50 cents, and this certificate will be renewed yearly without examination.

New Building of Northwestern Electric Equipment Company

The Northwestern Electric Equipment Company has recently completed and moved into its new home on East Sixth Street, St. Paul, Minn. The building, which is the largest in the Middle West occupied exclusively by an electrical jobbing house, is of reinforced-concrete construction, with 60,000 sq. ft. of floor space. On the first floor are the demonstration rooms, where industrial and residence fixtures, household electrical devices, etc., are shown. The office floor, which is lighted by the indirect system, is equipped with the Hackney electrically operated ventilating system, which changes the air every six minutes. Three electrically driven elevators are installed and a complete intercommunicating telephone system connects every department of the building. Approximately 13,600 ft. of "Greenfieldduct" and 72,000 ft. of "Americore" wire were used in wiring the structure, and 450 tungsten lamps are used to illuminate it. Electricity for all purposes is purchased from a central station. Mr. F. B. Thompson is president and treasurer of the company, Mr. J. M. Whalen is vice-president, Mr. A. J. Anderson is secretary and manager, and Mr. J. M. Hannaford, Jr., is manager of sales.

"Service" Versus "Price" in Electrical Contracting

Reading a paper before the recent convention of the Iowa Electrical Contractors' Association, Mr. Edward Kunkel, Davenport, said: "I consider the substitution of the word 'service' for 'price' an important element of modern business methods. Relegate to the rear the old idea that cheapness is the necessary and is the all-important feature in business getting, and make prominent the various elements that bring about good service.

"Don't let it be said any more that the John Jones Electric Company gets a lot of business because its price is always low. Rather let your patrons get the habit of saying to their friends: 'Get Jones to do your electrical work. He knows how. He keeps posted on everything and is up to date. He will take the time and trouble to tell you about something you need or ought to have and will explain it to you so that you will understand it and thank him for the suggestion. He will get his men on your job when he says he will, and when he is through it will be the job that is done, not you. He will go to considerable trouble to rearrange his workmen so as to get one of them to you in case of an emergency. He is always accommodating and obliging.'"

Merchandising and the New Idea

Industrial organizations are gradually awaking to the fact that business conditions can be bettered only by keeping in touch with cost and efficiency systems, and not by the continued cry for legislative protection. Some of the ideas of the Trumbull Electric Manufacturing Company, Plainville, Conn., on merchandising will probably be of value to those who are seeking to develop their organizations according to the new and progressive notions:

"To possess the fundamentals of merchandising a man must have the ability to comprehend the ideas of others and merge them with his own. If a business man is not an aggressive thinker, his brain will become sluggish, monotony will overpower him and his business, and both will fall into a rut. A man who cannot grasp business-getting ideas is like a person in a darkened room containing desired articles which cannot be obtained by groping about blindly.

"Merchandising is obtaining a higher percentage of net results, not through increased effort and hurry, but by thoughtfully directing every action. There are three marked periods in the growth of an industry: First, the period of inventions; second, the period of development, and third, systematizing the field. Most lines of business have developed quite far into the third period, and it is time that the electrical industry realizes that the inventive period is passing into the stage where it is necessary to develop high-grade merchants to sell the apparatus and obtain the most efficient methods of manufacture and distribution.

"What we all want for the electrical industry is a reputation for low credit, short-term payments, few failures and less readjustment. In addition, we need a crowd of men on a par with the best the country affords, who understand costs, know their field and can develop internal organization, which will enable them to distribute, manufacture, and wire or contract for electrical equipment with the highest economy and with a sure profit. More business acumen is the cry of the hour.

"When a business man knows the production cost, is sure of the efficiency of his organization, has cut out enormous waste, and knows what he can do on the capital available, then he can hold up his head in the face of any competitor and say, 'I'm on a rock; you can't oust me.' When this happy time of waste elimination comes the man who doesn't know his costs, who has no policy, whose only possible selling argument is 5 per cent better than the next man's price, will be promptly forced into the rear, because he cannot stand the pace. He will be like a man without training competing in a Marathon with a practised runner.

"Business is going to be a war between giants, not trust giants, but brain and efficiency giants. Tariff protection is going; the barriers of combinations and monopoly are burned away. Business is being thrown back on itself and its effective inside organization, no longer depending on the outside organization which, by clever manipulation, was employed to make profit where now brains and real efficiency only can show results. The time has come when there should be no more 'pools,' no more excessively high re-sales and no more high tariff that lets a man make 50 per cent without sweating his brow. Now is the period of individualism in business, greater freedom, but much greater responsibility. The solution for the keener competition that is coming is the development of the internal organization. This can be accomplished through better directed efforts, more initiative, more thought, more brains, all of which means more merchants engaged in the business.

"It is not so necessary for the distributer to have a highly protected re-sale price as it is to have a renewed efficiency of methods which will eliminate waste. We make so bold as to suggest that it would be the rarest good thing if the jobbers would get together, discuss methods of reducing the cost of doing business, thereby eliminating unnecessary expense and getting better results. It will be useless to worry about questions of protection, government investigation of associations, or established re-sales, important as they may be.

"Why shouldn't jobbers employ an efficiency engineer on a yearly basis just as lawyers are now employed by some firms to look into cost methods, stock handling, credit stability, latest accounting and office methods? Such an engineer could investigate each jobber's business, with a view toward helping him reduce the cost of doing business, then, as a benefit to all, submit reports on the conditions found so that all will be warned by the mistakes of others and helped by the improvements that are made. This is done in associations and other lines of business; nothing could be better for any branch of our trade. By sharing experiences and eliminating jealousy, other industries have greatly improved, to the advantage of every member.

"Mr. Gilbreth, the noted efficiency engineer, said he would like to see in our government a 'bureau of business,' which would take up these questions of business management and efficiency, and which would not only have literature and figures at the disposal of business men but would actually study the conditions of any line of trade and make harmony where chaos exists.

"There is not a manufacturer who knows on which side his bread is buttered but who is in intimate touch with cost and efficiency experts. The better ones have their own cost and accounting department. The best accounting system should be established, thus saving thousands of dollars and keeping a firm in touch with itself. Many business men are in touch with the trade but don't know much about their own business. Reverse this condition of affairs and be surest of yourself, and the trade will be all right.

"The man to be feared and the one who will be suppressed is the man who does not know his costs but mechanically cuts under. He is like a crazy man running through the streets, and, being crazy, he has no fear for his own life or respect for that of others. Efficiency engineers could convert such men into better citizens. Why can't the Society for Electrical Development, which has now raised the needed money to start, devote a certain part of its time to the development of better merchandising methods in the electrical trade? How can the industry be better 'boosted' than in boosting the standards of business methods? Are not such measures nearly as necessary as the sale of more 'juice'? Competition based on civilized warfare is all right, but the bushwhacking method is the wrong sort."

Conducting a Clearance Sale of Electrical Appliances

Special sales to dispose of electrical merchandise have been tried in a number of ways. Here is an example of a co-operative sale which was held in Cleveland. The work was started by the central-station representative laying the idea before the local merchants selling electrical appliances and obtaining their approval and promise of support. This settled, the local newspapers were approached to see if they would lend their aid toward making the sales a success by mentioning it in their shopping directories and news columns. This they promised to do. So much assured, the central-station company put out with its monthly bills some 50,000 leaflets reading as follows:

"The second week in September Cleveland stores selling electrical goods will hold the greatest special sale in the history of the business. A large selection of

Cleveland Stores Unite in Great Clearance Sale of
ELECTRICAL GOODS
Let nothing prevent your taking full advantage of this unusual chance to secure electrical appliances of the best makes.
THE LOW PRICES WILL ASTONISH YOU
THIS sale includes every kind of electrical appliance and convenience sold in Cleveland stores. The merchants whose offerings are listed here have united in this mighty clearance sale to make room for their fall goods and to demonstrate to the public the great variety of labor saving appliance now available for household and commercial use.
Electricity is the wonder-worker of the age. It has introduced economy, comfort, convenience and greater efficiency into home, store and factory.
Just the electrical convenience you've been wanting is on sale in one or more of these stores this week. Buy it now at a big saving.
THE STERLING & WELCH CO.
Many Real Bargains In Our Electrical Department During This Sale Week
Large Reading Lamps
$8 to $45
$19.50
Vacuum Cleaners
$15.00
Monarch Toasters
$2.25
New Era Flat Irons with Switch
$2.85
The STERLING & WELCH Co.
1325 Euclid Avenue
September Sale Electric Lamps
Hundreds of styles, all at less than regular price.
Delco Single Heat 6-lb. Electric Iron, fully covered by our personal guarantee
$4.00
Williams' 6-lb. Electric Iron, guaranteed for 5 years
$3.25
Blackstone Electric Washer, with reversible Wringer attachment, completely equipped with the latest type of enclosed electric motor. Costs for operating less than 2c per hour
$80.00
Eclipse Electric Vacuum Cleaner, light in weight, strong and durable; has double nozzle; is provided with stiff brush in front that picks up lint, thread, hair, etc. Complete with eight special tools. Guaranteed for one year
$38.00
The Geo. H. Bowman Co.
224-226-228 Euclid Ave.
Electric Sad Irons
Electric Vacuum Cleaners
Electric Diamond Water Heaters
Electric Curling Irons
Electric Fancy Art Reading Lamps
Electric Fans
The Geo. Worthington Co.
802 to 832 St. Clair Ave. N. W.
Three Glower Radiators
Water Heaters
Residence Type Fan Motors
Guaranteed Toasters
Family Washing Machines
THE REPUBLIC ELEC. CO.
2067-2069 E. 9th Opp. Scott Griggs
WE HAVE on hand a few Electric Ranges which have been used for demonstrating purposes. Except for a few slight mars in handling, these ranges are perfect in every detail. We offer them at the exceedingly low prices of $25 to $30 each. The advantages of Electric cooking at an initial expense of no higher than you would pay for an old-fashioned range.
THE ILLUMINATING CO.
Sales Department 232 Superior Ave. N. E.
Salzer's Introductory Special
GOOD FOR THIS WEEK ONLY
Cadillac Electric Vacuum Cleaner
Salzer Electric Flat Iron
SALZER ELECTRIC CO.
"To Serve You Electrically"
Main 1110. 633 Prospect Ave. Cent. 807-R.
Erner Electric Co.
We are offering the following Electrical labor-saving devices at reduced prices for this week only:
Electric Flatirons
Electric Toasters
Electric Washing Machines
Electric Percolators
Electric Stoves
Electric Flashlights
St. Clair Avenue and East 2nd Street
ENTERPRISE ELECTRIC
Special Offering
WASHING MACHINES
IRONING MANGLES
IRONS, TOASTERS,
PORTABLE LAMPS
FIFTY BARGAINS
It will pay you to call
The Enterprise Electric Company
6509-11 Euclid Ave., Vickers Bldg.
Annunciators Bells
Flashlights Fans
Heating Pads Irons
Fixtures and Shades
Percolators Radiators
Interphones
Reading Lamps
Vacuum Cleaners
The Western Electric Company
726 Prospect Ave. S. E.
Standard Make High Grade Electric Fans
SPECIALLY PRICED
The Kinney & Levan Co.
1375-1385 Euclid Ave.

FIG. 1—ADVERTISEMENT IN CLEVELAND PAPER

electrical appliances, including irons, toasters, washing machines, art lamps, fans, reflectors, etc., will be sold at sacrifice prices to make room for the fall goods.

"This will be the greatest opportunity ever offered to purchase standard electrical appliances at reduced

prices. That iron, washing machine or vacuum cleaner you have always wanted will be on sale somewhere at an astonishingly low price.

"Watch your newspaper for the announcement of the sale. Remember, one week only, beginning Sept. 8."

About 800 cards announcing the sale were also placed

The Western Electric Company
SUCCESSOR TO
THE CLEVELAND ELECTRICAL SUPPLY CO.
724-726 PROSPECT AVE. S.E.
CLEVELAND, OHIO.

IN REPLY REFER TO HAS-10-1-13.

REPLYING TO

Cleveland Electric Ill. Co.,

City.

Gentlemen:- Attention Mr. Wright.

I thought you would be interested to know that we were quite pleased with the results of the recent special sale.

Our cash sales during that week ran about $150 a day, which is quite above the average for that time of the year. We succeeded in getting rid of a number of shelf-worn items. We hope the sale will be an annual affair.

Yours truly,

MANAGER.

FIG. 2—REPORT OF PROMINENT JOBBER

in the street cars. Meanwhile the jobbers had been pushing the proposition among the small dealers and contractors with the idea of getting them to display appliances and cards announcing the sale in their windows. To boost the small contractors' business further

SALZER ELECTRIC CO.
CLEVELAND OHIO

November
Third
1913.

The Illumiating Co.

City.

Gentlemen:- Attention Mr.R.H.Wright.

Refering to the electrical sale,which was given some weeks ago,we wish to inform you,that we had very satisfactory results. In fact,we sold approximately sixty irons as advertized,and received a goodly number of prospects on the vacuum cleaner.

We state,that sales of this kind held from time to time will stimulate the use of electrical appliances,and we will be ever ready to assist in a proposition of this kind.

Yours very truly,

SALZER ELECTRIC COMPANY.

HAS/S Secretary.

FIG. 3—RESULTS FROM SALES OF IRONS AND VACUUM CLEANERS

and make them feel that the efforts of the jobbers were made in their behalf, a display was made to go in the window of the central station. This display consisted of a large outline map of the city of Cleveland 14 ft. long and 6 ft. high. The location of each merchant was shown by placing his name and address in good-sized letters on the map. The articles each particular store had for sale were listed on a card, together with the address of the store selling them. These cards were placed on the floor of the window, and a ribbon connected the card to the dealer's name shown on the map. To give life to this display small round holes were cut in the map close to the dealer's name and tungsten lamps on thermostatic plugs were placed back of these holes.

The show window was made attractive by draping a few American flags in the corners. The cost of this display was borne by the jobbers. During the week of the sale display advertisements were published in two morning papers and one evening paper. In this advertising the central-station company bore the expense of the heading of the advertisement, and each dealer paid for the space used by his copy as shown. Copies of

THE ERNER ELECTRIC COMPANY

CLEVELAND 11/15/13

IN REPLY REFER TO GSM-LS

ADDRESS ALL LETTERS TO THE COMPANY

Cleveland Electric Illuminating Co.,

Cleveland, Ohio.

Atten. - Mr. Wright.

Gentlemen:-

With reference to the special sale of electrical material in which the Cleveland Electric Illuminating Company and the electrical dealers co-operated for one week during the month of September, Our records do not give us a very accurate idea of just what the results of this sale were.

We, however, are satisfied that the campaign produced some results and that if the idea is carried out once or twice a year the accummulative effect of the advertising and the sale will produce large results from year to year.

This idea is so new in the electrical line that it will take a few years, in our opinion, to produce in the mind of the public the idea that electrical goods may be purchased at clearance sale prices the same as other merchandise.

Very truly yours

THE ERNER ELECTRIC COMPANY

Sales Manager.

FIG. 4—JOBBING HOUSE'S OPINION OF SPECIAL SALE

these advertisements were put in the display room of the central station and dealers' stores and windows. The newspapers made good their promise of boosting the sale both in reading notices and in their shoppers' guides. This is extremely valuable publicity and should not be overlooked. Displays of the articles on sale in the dealers' windows are also a feature not to be overlooked.

The particular articles each merchant should list and what discount he should give was left to his individual judgment. Some put up for sale only shopworn articles and dead stock, while others gave a straight 10 per cent discount on any article in their store. The results of the sale are probably best shown by statements made by the managers of some of the firms participating, as shown in the three letters from prominent jobbers and dealers of Cleveland reproduced.

Industrial and Financial News

Public Utility, Commercial, Corporate and Trade Developments—The Electrical Material and Security Markets

New Name for Research Laboratory.—The director of the physical laboratory of the National Electric Lamp Association announces that hereafter the laboratory will be known as the Nela research laboratory of the National Lamp Works of the General Electric Company.

Increasing Space in New York Office.—The Electric Controller & Manufacturing Company (Cleveland, Ohio) is doubling its office space at 50 Church Street, New York, to meet the requirements of increased business in the East. Business conditions for this company are reported to be very good.

Steel Transmission Towers for Southern Utility.—The Riter-Conley Company, Pittsburgh, has received an order for 2000 steel towers for use on the high-tension transmission system of the Southern Power Company, of Charlotte, N. C. The towers will be made at the company's Leetsdale plant.

New High-Pressure Expansion Joint.—A new expansion joint for high-pressure service has been developed by the Alberger Pump & Condenser Company. A nest of circular disks, stamped from steel plates, is provided. These disks are welded together, forming a flexible bellows which absorbs the movement of the pipe line.

Conduit Business Good.—Mr. G. M. Gest, conduit engineer, finds business very good. Numerous installations are being made both in the United States and Canada. On account of the late spring, conduit work in the North has been held up considerably, and the amount of work completed on this account is smaller than that at the same time last year.

Westinghouse Office in Des Moines.—The Westinghouse Electric & Manufacturing Company has established a sub-office in Des Moines in charge of W. E. Gant. The office is located at 310 Citizens' National Bank Building. This makes the third office of the Westinghouse Electric & Manufacturing Company in Iowa, the others being at Burlington and Waterloo, in charge, respectively, of A. M. Miller and H. H. Caughlin. These sub-offices report to the district office in Chicago.

Brass Industry Healthy.—A representative of the American Brass Company states that, although business is only about 60 per cent of what it should be and the outlook for an increase in the near future is not promising, the industry is managing to hold its own very well. It is noteworthy, he adds, that none of the larger companies dealing in copper supplies are overstocked. The cheapness of copper at the present time is also a factor in putting the brass and other copper-alloy products on a firm basis.

Wide Field for Induction Motors.—Both direct-current and alternating-current motors are being placed on the market by Fairbanks, Morse & Company, the sales of the latter amounting to about double the former. The internal-starter motor recently developed by this company is meeting with considerable favor, and it is being used quite extensively for elevator service and irrigation pumping. This machine has an interesting starting device the action of which depends upon the varying resistance of carbon contacts under pressure.

Contract Awarded for Construction of Steel Plant.—Westinghouse, Church, Kerr & Company, New York City, have been engaged by the Taylor-Wharton Iron & Steel Company for the design and construction of a plant for William Wharton, Jr., & Company, Inc., to be erected at Easton, Pa. The plant will cover 25 acres and will include machine and grinding shop, blacksmith shop, foundry, pattern shop, storage buildings, office buildings and power plant. Construction work is to begin at once. The plant will be completed and in operation within one year.

Electric Motors Supplied for Operating Ore-Dock Chutes.—The Ideal Electric & Manufacturing Company, of Mansfield, Ohio, has recently shipped to the Duluth, Mesaba & Northern Railway Company, of Duluth, Minn., thirty-two 25-hp, three-phase, twenty-five-cycle, squirrel-cage induction motors, to operate at 750 r.p.m. on 440-volt circuit. This railroad is a subsidiary of the United States Steel Corporation, and the motors are part of the equipment of the new No. 5 iron-ore dock which it is building at the above location and which is said to be the largest in the world. Each of the above motors will, when installed, operate a bank of twenty-four chutes.

Orders for Splicing Sleeves and Insulator Clamps.—The Clark Electric & Manufacturing Company, 149 Broadway, New York, has recently made a shipment of seamless copper splicing sleeves for use on the United States government transmission lines in the Panama Canal zone. Another order for sleeves and also a large number of insulator clamps has been received from the Otter Tail Power Company, Fergus Falls, Minn. This material will be used on a 75-mile transmission line which the company will build this year. Overhead clamping sets for use on the right-of-way of the Rochester Railway & Light Company are being furnished by the above company.

Refrigerating Equipment Installed in New York.—A contract was recently awarded to the Carbondale Machine Company for two 50-ton refrigerating machines and a 20-ton Parsons quick-freezing plant to be installed in the new Equitable Building. A high-pressure and low-pressure brine system is employed, and the brine pumps are driven both by steam and electricity. In the Hudson Terminal Building, at 50 Church Street, a 15-ton Parsons quick-freezing plant is being installed as an addition to the equipment already in use. Two 100-ton refrigerating machines were supplied recently to the National Cold Storage Company, Brooklyn, N. Y. A large number of alterations and improvements are also being made to installations already in operation. The sales in refrigerating apparatus are found to be greatest in the spring.

Motors for Iron and Steel Industry.—Included in the electrical machines ordered by various iron and steel companies have been a large number of motors. The American Iron & Steel Manufacturing Company, Lebanon, Pa., will add to the electrical equipment in its mill a 150-hp induction mill-type motor with sectional-control equipment. The Bethlehem Steel Company, South Bethlehem, Pa., has ordered two 150-hp motors, two 125-hp motors and nine motors rated at from 10 hp to 50 hp. The Riter-Conley Company, Pittsburgh, Pa., has ordered two motors rated at 10 hp and 25 hp. The Hubbard Steel Foundry Company, East Chicago, Ind., will add to the electrical equipment of its plant two 100-kva synchronous motors with 5-kw exciters and accessories. The orders for these machines have been placed with the General Electric Company.

Montreal Utility Orders Switchboard and Transmission Line Equipment.—The Cedars Rapids Manufacturing & Power Company has let the contract for a 66,000-volt transmission line, which will run from the plant to the step-down station at Côte St. Paul, a suburb of Montreal, a distance of about 30 miles. The Canadian Allis-Chalmers Company, Ltd., will supply the steel poles, which will be lattice type, 40 ft. high, and the aluminum, steel-reinforced wire will be manufactured by the Northern Aluminum Company, of Shawinigan Falls, Quebec. The General Electric Company has obtained the contract for the switchboard

equipment of the 100,000-hp hydroelectric development now being built at Cedars, Quebec. Mr. R. M. Wilson, of the Montreal Light, Heat & Power Company, is the electrical and Mr. Julian C. Smith, of the Shawinigan Water & Power Company, the hydraulic engineer of the company.

Friendly Relations with Latin-American Republics.—Addressing the Peoria (Ill.) Transportation Club on April 30, Mr. E. N. Hurley, vice-president of the Illinois Manufacturers' Association and president of the Hurley Machine Company of Chicago, made a plea for high-class salesmanship in dealing with the business conditions in Central and South America. Salesmen sent down there from the United States must speak the language of the country to which they are sent, must understand the people with whom they deal, and must have a real and sympathetic comprehension of the needs of the country. If American manufacturers will devote the same keen attention to developing their business in Latin America that they do to the field at home, there is no reason why they should not win a large measure of success.

Lighting-Pole Business from Two Standpoints.—The Electric Railway Equipment Company, of Cincinnati, Ohio, has experienced a slump in most of its lines, but its lighting-pole business has been encouraging and a further increase is expected. The reason advanced for this is that in the spring the installation of the poles is easier and more seasonable, as a part of the general construction activity at that time of year. Another manufacturer of the same product states that his business has fallen off largely, in accordance with his expectations, in view of the approach of summer, when the demand for street lighting is not so urgent and when general business activity is usually not so great as in the winter months. Since both are active concerns and are doing business over a wide territory, it is interesting to observe that the reasons given for differences in present business are exactly opposed.

Electrical Apparatus for Western Power Stations.—A number of power companies in the West have recently ordered electrical equipment for their power stations. Four 10,000-kva waterwheel-driven generators, two 500-kw generators, nine 6000-kva water-cooled transformers, nine 360-kva reactances, a switchboard and accessories will be installed in the station of the Great Falls Power Company, and the Thompson Falls Power Company, of Butte, Mont., will install two 6250-kva waterwheel-driven generators, two 500-kw generators, four 3750-kva water-cooled transformers and a switchboard with accessories. The Eastern Michigan Power Company, Jackson, Mich., will add to the equipment of its plant at Flint, Mich., a 690-kva Tirrill regulator The Great Western Power Company, San Francisco, Cal., will add to the equipment of the Big Bend power house two 150-kw, three-unit motor-generator sets and a switchboard with accessories. All of this equipment will be supplied by the General Electric Company.

NEW YORK METAL MARKET PRICES

	April 28		May 5	
Copper	Bid	Asked	Bid	Asked
Standard spot*	13.37½	14.00	13.40	14.00
	Selling Prices		Selling Prices	
	£ s d		£ s d	
London, standard spot*	63 15 0		63 7 6	
Prime Lake	14.37½	to 14.62½	14.37½	to 14.62½
Electrolytic	14.10	to 14.20	14.10	to 14.20
Casting	14.00	to 14.10	14.05	to 14.15
Copper wire base	15.25		15.25	to 15.50
Lead	3.90		3.90	
Nickel	40.00	to 45.00	40.00	to 45.00
Sheet zinc, f.o.b. smelter	7.00		7.00	
Spelter, spot	5.00	to 5.10	5.05	to 5.15
Tin, spot	34.37½	to 34.62½	33.05	to 33.15
Aluminum:				
Prompt delivery	17.75	to 18.00	17.75	to 18.00
Future	17.75	to 18.00	17.75	to 18.00

*OLD METALS

Heavy copper and wire	12.87½	12.87½
Brass, heavy	8.62½	8.62½
Brass, light	7.50	7.50
Lead, heavy	3.90	3.90
Zinc, scrap	4.15	4.15

*COPPER EXPORTS

Total tons to May 5 4,650

*From daily transactions on the New York Metal Exchange.

Corporate and Financial

Directors of United Railways Investment Company.—A. J. Hemphill, U. S. Chesbrough and H. I. Miller have been elected directors of the United Railways Investment Company to succeed Patrick Calhoun, George E. Shaw and Sidney March, resigned.

American Gas & Electric Company Earnings.—Gross earnings of the American Gas & Electric Company for the calendar year 1913 were $3,811,292, an increase of $472,522 over 1912. Net earnings were $1,024,715, a gain of $109,276. The surplus remaining after provision for fixed charges was $680,303, or an increase of $64,034.

Fixture Manufacturer in Difficulty.—Mr. James E. Hegan, president of the Hegan Manufacturing Company, of Louisville, which dealt extensively in electric-lighting fixtures and against which involuntary proceedings in bankruptcy were begun some time ago, has filed a voluntary petition in the federal court. He lists his liabilities at $26,389.12 and his assets at $56,694.33.

Earnings of Northern States Power Company.—President H. M. Byllesby reports for the year ended March 31, 1914, that gross earnings of the Northern States Power Company were $3,962,033; net earnings were $2,043,398; fixed charges $1,232,109, leaving a surplus of $811,288, from which $580,263 was paid out in preferred-stock dividends.

Valuation of Washington (D. C.) Utility.—The J. G. White Engineering Corporation has been retained by the Capital Traction Company, of Washington, D. C., to make a complete inventory and valuation of its property. This valuation is to be made simultaneously with a valuation of all public utilities in the District by the Public Utilities Commission of the District of Columbia, in accordance with the provisions of the act of Congress passed March 4, 1913, creating that commission.

Central-Station Output and Earnings for Month of March.—Central-station statistics for March received from companies operating in practically all of the larger cities in the country serve to bring out clearly how great a percentage of the energy output of the entire United States is furnished by a few large companies. In many of the largest metropolitan areas the local central-station company actually furnishes service to a far greater number of people than is indicated by the population figures of the city in which its headquarters are located. In New Jersey, California, Washington and many other states the major portion of the needs of the whole state is supplied by a single system directed from the largest city in the territory. There are several such organizations in the country whose earnings in a single month run above the million-dollar mark. For the month of March the gross earnings of all the companies in the country may be placed at a little over $31,000,000, and returns which the *Electrical World* has received from the companies operating in practically every one of the twenty-five largest cities show that these companies between them earned something in excess of $13,000,000 in the month. The gross was $12,440,100 for March, 1913, and $13,426,100 for March, 1914, the increase being $986,000, or practically 8 per cent. It can be seen that this figure is more than 43 per cent of the earnings of the entire industry. In the month of March the energy output of the whole country may be placed at 1,240,000,000 kw-hr., and returns from the twenty-five largest cities show that their share of this output was 511,000,000 kw-hr., or about 41 per cent of the whole. The gross yield per kilowatt-hour for these companies was therefore 2.63 cents, which agrees very closely with the average derived from the 1912 census of the entire industry. It should be noted that, while the foregoing statement of the industry's earnings for March rests practically upon a bedrock of official data, the figures relating to kilowatt-hours involve supposition. Official data on the matter of station output, however, are sufficiently numerous and representative to make possible a close estimate that the energy produced in the twenty-five largest cities in the country increased from 475,000,000 kw-hr. in March, 1913, to 511,000,000 kw-hr. in March, 1914.

Business Notes

C. O. Mailloux, consulting engineer, has removed his office from 90 West Street, New York, to 20 Nassau Street, New York.

Lotz & Scheible, patent lawyers and patent advisers of Chicago, have moved to larger quarters at 1063 McCormick Building, 332 South Michigan Avenue. Albert Scheible, an electrical man of wide acquaintance, is a member of this firm.

The Walpole Tire & Rubber Company, of Walpole, Mass., has abandoned its sales office at Boston, Mass. The general offices are at Walpole, Mass., and all communications should be addressed to the receivers of the company at the latter place.

Sargent & Lundy Remove Their Offices.—Sargent & Lundy, mechanical and electrical engineers, who for many years have had their offices in the Railway Exchange, Chicago, have removed to 1412 Edison Building, 72 West Adams Street, Chicago. This new Edison Building is the former Commercial Bank Building, recently acquired as the headquarters building of the Commonwealth Edison Company.

McMeen & Miller Open Cleveland Office.—McMeen & Miller, engineers, of Chicago, have opened a branch office at 407 Electric Building, Cleveland, Ohio. Mr. Allen C. Morse, who has been engaged in engineering work for several years, has been chosen as resident engineer and manager of the new office. McMeen & Miller do general engineering work, devoting particular attention to the rehabilitation of plants, the making of appraisals and the establishment of proper systems of records.

New Industrial Companies

The Stites Automatic Signal Light Company, of Plainfield, N. J., has been incorporated with a capital stock of $50,000, to manufacture automatic signal lamps, etc., by A. B. Stites, H. L. Stites and E. Seeley, of Plainfield, N. J.

The American Products Company, of Canton, Ohio, has been incorporated by P. D. Miller, R. L. Miller, J. V. Stahl and I. A. Arnold. The company is capitalized at $15,000 and proposes to manufacture and deal in electrical appliances.

The Chelsea Manufacturing Company, of Newark, N. J., has been granted a charter with a capital stock of $100,000 to manufacture motors, engines, machinery, etc. The incorporators are E. R. Mills, L. E. Hall and O. F. Root, of East Orange, N. J.

The R. K. Mickey Company, of Bloomfield, N. J., has been incorporated by R. McNeill, of New York, N. Y.; M. L. Mickey and R. K. Mickey, of Bloomfield, N. J. The company is capitalized at $50,000 and proposes to manufacture incandescent electric lamps, etc.

The J. N. Johns Manufacturing Company, of New York, N. Y., has been incorporated with a capital stock of $25,000 by A. A. Ewald, A. Ackerson, of New York, and J. Rubin, of Brooklyn. The company proposes to manufacture and deal in steam and electric supplies, car trucks and wheels, etc.

The Sun Electrical Manufacturing Company, of Burrage, Mass., has been chartered with a capital stock of $25,000 to manufacture electrical supplies. The incorporators are G. B. Levy, of Brookline; Julius Nelson, of Boston; Samuel O. Reinstein, of Brookline, and Frank Sanford, of Bryantville.

The Crescent Engineering Company has filed articles of incorporation under the laws of the State of Delaware with a capital stock of $100,000, to do a general mechanical and electrical engineering business. The incorporators are F. R. Hansell, of Philadelphia, Pa.; G. H. B. Martin and S. C. Seymour, of Camden, N. J.

The Interstate Hydrostat Company, of Buffalo, N. Y., has been incorporated with a capital stock of $200,000 by Charles B. Sherwood, of Buffalo, N. Y.; Michael Owen, Anthony J. Eckel, William Eckel and Dr. S. A. Lenhard, of Detroit, Mich. The company proposes to manufacture electrical machinery, engines, boilers, etc.

Trade Publications

Flashers.—The Reynolds Electric Flasher Manufacturing Company, 422 South Talman Avenue, Chicago, Ill., is mailing a large card containing Suggestion No. 5, which refers to flashing signs for drug stores.

Used Scientific Apparatus and Instruments.—The Leeds & Northrup Company, of Philadelphia, Pa., has issued a descriptive price list on odd stock and used electrical apparatus and instruments for laboratory use.

Switches.—Bulletin No. 27 of the Detroit Fuse & Manufacturing Company, Detroit, Mich., is devoted to its ironclad entrance switch. This switch is made for two-wire and for three-wire circuits at 30 amp and 125 volts.

Storage-Battery Operation.—A small four-page folder just issued by the Electric Storage Battery Company, of Philadelphia, Pa., gives instructions for the receiving of a new battery of its make and for the operation of the same.

Electrical Specialties.—Harvey Hubbell, Inc., of Bridgeport, Conn., has recently put out a large catalog on its various manufactures of lighting supplies and fixtures. The book is well illustrated and gives complete information concerning the extensive line of this apparatus which the Hubbell company markets.

Rope.—Manila rope for transmission and hoisting is the subject of Catalog No. 12-8 recently issued by the C. W. Hunt Company, West New Brighton, New York. It was written by Mr. C. W. Hunt and is an interesting, well-prepared and instructive pamphlet on ropes used for the transmission of torque. It contains formulas, tables and data useful in mill engineering. The illustrations are excellent and well selected.

Sterilization of Water.—In a pamphlet of thirty-two pages the R. U. V. Company, Inc., 50 Broad Street, New York, illustrates the R. U. V. system of water sterilization in hospitals, hotels, factories, railway stations and apartment houses. Reports are given of tests of the system in various laboratories. It is claimed for this system that any amount of water varying from 20 gal. to 200,000 gal. an hour can be successfully treated.

Governors.—"Lombardata" II, a card, size 7¼ in. by 5⅜ in., shows a map of New York State. On it are indicated in red dots the installations of Lombard governors on the New York Barge Canal. A miniature illustration is shown of one of the Barge Canal governors, of which fifty-eight are installed on the waterwheels in the plants of the system from end to end. This card is issued by the Lombard Governor Company, Ashland, Mass.

Lamps.—The engineering department of the National Lamp Works of the General Electric Company, Cleveland, Ohio, has recently issued a number of new bulletins. Bulletin 8E refers to miniature tungsten lamps. Bulletin 13D contains technical data concerning 750-watt and 1000-watt multiple tungsten lamps, their accessories and their uses. In Bulletin 11B tungsten street series lamps are discussed and the more essential operating considerations are set forth.

Guards for Machinery.—The increasing interest in accident prevention makes timely the booklet issued by the Consolidated Expanded Metal Company, Architects' Building, New York. This publication contains information regarding its "Steelcrete" guards for machinery. There are many excellent illustrations which serve to demonstrate the adaptability of "Steelcrete" mesh to the construction of machine-tool guards and other protecting devices. This material is also used for racks, window guards and small partitions in shelves.

Electric-Lighting Sets for Private Service.—Catalog A of the Petschel Storage Battery Company, 3051 West Lake Street, Chicago, describes complete electric-lighting sets, for country or other service, designed for 32 volts, 60 volts or 110 volts. Battery cells are furnished in glass jars or rubber jars, the latter costing a little more. One of the 60-volt plants is designed especially to give electric service for moving-picture theaters. Each set includes the battery, switchboard, small dynamo and gasoline engine. Illustrations showing the new factory of the company are given in this catalog.

Personal Mention

Mr. Percy Warner has resigned as president of the Nashville (Tenn.) Railway & Light Company.

Mr. B. O. Brown has been appointed assistant superintendent of the Electric Light Company at San Domingo, Hayti.

Mr. B. F. Eyer has been appointed general manager of the Marshall County Power & Light Company, of Blue Rapids, Kan.

Mr. H. Merrifield, formerly of Springfield, Ill., has been appointed superintendent of the Mankato (Minn.) division of the Consumers' Power Company.

Mr. Curtis C. Curry has been made branch manager at Minneapolis for the Westinghouse Electric & Manufacturing Company, succeeding Mr. Walter D. McDonald.

Mr. Douglas I. McKay, until recently police commissioner of the city of New York, has been appointed first assistant to Mr. Gano Dunn, president of the J. G. White Engineering Corporation.

Mr. William O'Hallaren, chief engineer and chief electrician of the Newmarket (Ont.) Municipal Electric Light & Water Works, has tendered his resignation after seventeen years of service.

Mr. Corliss Kemery, assistant manager of the Shenango Valley Electric Light Company, has been appointed superintendent of the local office at Sharon, Pa., as successor to Mr. J. C. Chestnut.

Mr. M. D. Leslie has resigned as superintendent of the light and water department of the city of Mulberry, Kan., and has accepted a similar position with the municipal light and water works at Russell, Kan.

Mr. Eugene H. Bell, formerly of Youngstown (Ohio), has been appointed manager of the Youngstown (Ohio) Consolidated Gas & Electric Company, including the branches at New Castle, Sharon and Ellwood City.

Mr. C. G. Johnson, formerly manager of the Chickasha (Okla.) Light, Heat & Power Company, has been appointed general manager of the Vicksburg (Miss.) Light & Traction Company, succeeding Mr. A. J. Bemis.

Mr. F. N. Kollock, Jr., until recently district manager for the Westinghouse Electric & Manufacturing Company at Seattle, Wash., has been made treasurer of the Westinghouse Lamp Company, with office in New York City.

Mr. Walter D. McDonald, formerly branch manager at Minneapolis for the Westinghouse Electric & Manufacturing Company, has been appointed district manager for that company at Seattle, succeeding Mr. F. N. Kollock, Jr.

Mr. Percy M. Ayer has been elected president of the Plymouth (N. H.) Electric Light Company. Mr. Ayer, who is just twenty-one years of age, is probably the youngest manager of an electric-light plant in the State of New Hampshire.

Mr. J. C. Chestnut, formerly superintendent of the Shenango Valley Electric Light Company at Sharon, Pa., has been appointed manager of the New Castle (Pa.) Electric Company, a subsidiary of the Mahoning & Shenango Valley Electric Company.

Mr. E. T. Munger, general manager of the Cumberland County Power & Light Company, of Portland, Maine, has been relieved of his duties owing to illness, and Mr. Alfred Sweeney, who has been assistant to the general manager, will act in his stead for the time being.

Mr. Thomas J. Duncan has resigned as superintendent of the Ocean City (N. J.) Electric Light Company. Mr. Duncan was in charge of that property for the last thirteen years, during eleven of which he was also superintendent of the Ocean City Electric Railroad Company.

Mr. George F. Atwater has been appointed superintendent of the United Electric Light & Water Company at New Britain as successor to the late L. S. Risley. Mr. Atwater is at present superintendent of the Greenwich office of the company. He is a graduate of Yale and was formerly connected with the company at South Norwalk and at Naugatuck.

Mr. Elmer Lingard, formerly connected with the United Electric Light & Water Company, has been appointed superintendent of the new East Norwalk municipal electric plant. The district recently voted $25,500 for a new plant and site, and Mr. Lingard will assist the commissioners in the plans and in the selection of the equipment.

Mr. L. W. Hess, general superintendent of the Northern Illinois Light & Traction Company of Ottawa, Ill., one of the McKinley properties and closely allied with the Illinois Traction System, has been put in charge of the Citizens' Lighting Company of LaSalle, Ill., which is also a McKinley property. Mr. Hess will retain his headquarters in Ottawa.

Mr. J. T. Shannon, commercial agent of the United Electric Light & Water Company at Waterbury, Conn., has been appointed superintendent of the Greenwich office as successor to Mr. G. F. Atwater, who has been transferred to New Britain. Mr. Shannon joined the staff of the United Electric Light & Water Company in June, 1912, having come from Cincinnati, Ohio, where he was then working with the Central Electric Company.

Mr. Patrick Calhoun, who resigned last year as president of the United Railroads of San Francisco, has tendered his resignation as a director of the United Railways Investment Company, which owns or controls most of the stock of the California Railway & Power Company. The latter company in turn controls the United Railroads, the Sierra & San Francisco Power Company, the Coast Valleys Gas & Electric Company and the San Francisco Electric Railways.

Mr. P. S. Young, who has been comptroller of the Public Service Corporation of New Jersey, Newark, N. J., has been elected treasurer of the company to succeed Mr. James P. Dusenberry, who has retired, having reached the age limit fixed by the company. The offices of comptroller and treasurer have been consolidated, and Mr. W. S. Barker, formerly assistant comptroller, has been appointed an additional assistant treasurer to serve with the present assistant treasurers, Mr. R. D. Miller and Mr. T. W. Van Middlesworth.

Mr. J. S. Pevear, second vice-president of the New Orleans (La.) Railway & Light Company since last fall, has been elected president of the company, which position has been vacant since the election of Mr. Hugh McCloskey as chairman of the board of directors and president of the American Cities Company. Mr. Pevear was formerly vice-president of the International Railway and vice-president of the Buffalo & Lake Erie Traction Company, of Buffalo, N. Y. He became general superintendent of the latter company in 1911, having been previously connected with the Twin City Rapid Transit Company of Minneapolis and with the General Electric Company.

Mr. W. G. Murrin has recently been appointed general superintendent of the British Columbia Electric Railway, Ltd., with headquarters at Vancouver, B. C. His work will cover duties of mechanical superintendent with control of equipment over the company's entire system as well as the supervision of the Vancouver & Suburban division of the company's railway system. Mr. Murrin went to British Columbia from England last year to take the position of mechanical superintendent. His early technical training was obtained in the Finsbury Technical College, after which he served as apprentice in the shops of the City of London Lighting Company. He subsequently served as superintendent of power on the London United Tramways and later was appointed manager of rolling stock and electrical equipment and works manager of the London company.

Obituary

Frederick W. Burdick, for the past ten years manager of the contracting department of the H. W. Johns-Manville Company, died at his home in New York on April 28.

George H. Potter, president of the Bradford (Pa.) Light, Heat & Power Company, died April 27. Mr. Potter was born at Rockford (Ill.) July 12, 1847, served during the Civil War, and later went to the oil regions and located at Petroleum Center. He is survived by a widow and a daughter.

Construction

New England

PRESQUE ISLE, MAINE.—The Maine & New Brunswick Electrical Co., of Presque Isle, expects to erect 8 miles of three-phase, 11,000-volt transmission line, extending from Presque Isle to Mapleton. C. O. Austin is superintendent.

NEWTON, N. H.—The Exeter & Hampton El. Lt. Co. has decided to extend its transmission line to Newton to furnish electrical service here.

BOSTON, MASS.—Bids will be received at the office of the supervising architect, Treasury Department, Washington, D. C., until June 10 for furnishing and installing lighting fixtures in the United States custom house in Boston, Mass. For details see proposal columns.

BROCKTON, MASS.—Within the next two months the Edison El. Illg. Co. of Brockton expects to erect a 13,200-volt transmission line from its East Bridgewater plant to a substation in the town of Bridgewater. The company is now extending its lines into the towns of North Hanson, South Hanson, Bryantville and Pembroke for the purpose of furnishing the residents with electrical service. A. F. Nelson is manager.

CHICOPEE, MASS.—The Water Department is contemplating equipping the waterworks pumping station with two electric motors of 100 hp each to replace steam power.

FALL RIVER, MASS.—The aldermanic committee has approved plans for the installation of ornamental lamps on Morgan Street.

GREENFIELD, MASS.—The Greenfield El. Lt. & Pwr. Co. is negotiating with the residents of Ashfield with a view of furnishing electrical service in that town. If the deal is carried through, the service will be extended to cover Ashfield Plains and South Ashfield before fall.

LUNENBURG, MASS.—The town of Lunenburg has voted to establish a municipal electric distributing system and to appropriate an amount not exceeding $10,000 for same. It is proposed to purchase electricity to operate the system.

MALDEN, MASS.—The Malden El. Co. is expecting to purchase one 600-hp Babcock & Wilcox water-tube boiler equipped with Murphy stokers. J. T. Day is superintendent.

WORCESTER, MASS.—The Worcester El. Lt. Co. has entered into a contract with the Crompton & Knowles Loom Works, whereby it will furnish electricity to operate the plant of the latter. The connected load at the works will be about 1600 hp in 550-volt, three-phase induction motors and about 200 kw in lighting apparatus. The electric company will also furnish about 400 hp for the new industrial building being erected by John E. Bradley, at Grafton and Franklin Streets.

PROVIDENCE, R. I.—Bids will be received at the office of the Board of Contract and Supply until May 11 for electrical work at the Courtland Street School. Plans and specifications may be obtained at the office of Hoppin & Field, architects, 32 Westminster Street, Providence.

BRISTOL, CONN.—The directors of the Bristol & Plainville Tramway Co. have recommended an increase in capital stock from $375,000 to $562,000, the proceeds to be used for extensions and betterments.

BRISTOL, CONN.—The New Departure Mfg. Co., of Bristol, has signed a contract with the Bristol & Plainville Tramway Co. to furnish electricity to operate its manufacturing establishment. It is understood that the contract calls for 3000 hp, which will be furnished from the power plant of the Stone & Webster Corpn., of Boston, Mass., at Falls Village, on the Housatonic River.

EAST NORWALK, CONN.—Bonds to the amount of $20,000 have been voted for the installation of an electric generating plant. Electricity for operating the municipal electric-light system is purchased from the municipal electric plant at South Norwalk.

Middle Atlantic

BINGHAMTON, N. Y.—The City Council has decided to call an election on May 19 to submit the proposal to issue $148,000 in bonds for the installation of a municipal electric-light plant in Binghamton.

FULTON, N. Y.—The Fulton Lt., Ht. & Pwr. Co. expects to purchase the following material for street-lighting system: 25 miles of No. 6 wire, 210 30-ft. poles, 500 crossarms, 500 12-in. bolts, 1000 square washers, 500 lags, 500 pair cross-arm braces, 400 No. 222 Pierce brackets, 400 Lock No. 44 insulators, 2000 high-voltage insulators, three 25-kw constant-current transformers, complete with panels, etc., 424 reflectors and 268 fixtures. The company would like to receive prices direct from manufacturers on the above. J. J. Jordan is general manager.

HUDSON, N. Y.—Bids will be received until May 25 by Miss Mary Hinckley, president of the board of managers, New York State Training School for Girls, Hudson, for electric work in cottages Nos. 1, 2, 3 and 4 at the New York State Training School for Girls at Hudson. Drawings and specifications may be seen and blank forms of proposal obtained at the training school at Hudson and at the office of Lewis F. Pilcher, state architect, Capitol, Albany. Plans and specifications may be obtained on application to the state architect.

ITHACA, N. Y.—Bids will be received by E. L. Williams, treasurer of Cornell University, Ithaca, N. Y., until May 15 for the electric-service connections for the forestry building, animal husbandry headquarters building, stock-judging pavilion and agronomy building at the New York State College of Agriculture, Cornell University, Ithaca. Specifications and blank forms of proposal may be obtained at the office of Green & Wicks, 110 Franklin Street, Buffalo, N. Y., for which a deposit of $10 will be required. Specifications are on file in the office of Lewis F. Pilcher, state architect, Capitol, Albany, and at the office of the treasurer at Cornell University, Ithaca.

NEW YORK, N. Y.—Bids will be received by Douglas Mathewson, president of the borough of the Bronx, Municipal Building, Crotona Park, 177th Street and Third Avenue, until May 15 for furnishing and installing electric and gas fixtures in the Bronx Borough court house. Blank forms can be obtained and plans and specifications may be seen at the above office.

SYRACUSE, N. Y.—The Public Service Commission has granted the application of the Syracuse Ltg. Co. for permission to erect a transmission line to Minoa to supply electricity for lamps and motors in that town.

CONNELLSVILLE, PA.—The garage owned by the Wells-Mills El. Co., of Connellsville, was recently destroyed by fire, causing a loss of about $8,000.

EASTON, PA.—The City Council has authorized the superintendent of the Department of Highways to advertise for proposals for the extension of the street-lighting system. It is proposed to erect 117 ornamental standards on Northampton and Third Streets to supplant the 22 arc lamps now in use. Tungsten lamps of the new nitrogen type will be used.

HERSHEY, PA.—The power plant of the Hershey Chocolate Co., it is reported, was badly damaged by fire recently, destroying an engine and six generators.

PHILADELPHIA, PA.—Plans, it is reported, have been submitted for estimating on the construction of power houses along the main line of the Pennsylvania Railroad. Philadelphia contractors have already been asked for bids on a power house to be erected at Broad Street and Glenwood Avenue.

PHILADELPHIA, PA.—The United El. Construction Co., 1727 Sansom Street, Philadelphia, has been awarded the contract for the installation of engines, generators, switchboard, telephones, program clocks, elevators, etc., to be installed in the Germantown High School, to be erected at Germantown, Philadelphia. The cost of the work is estimated at about $50,000.

LONACONING, MD.—The Home El. Lt. Co., of Lonaconing, is expecting to purchase within the next three months one 200-kw to 250-kw single-phase, 2300-volt alternating-current generator and one 300-hp to 400-hp engine to drive same. The company has taken over the plant of the Lonaconing Lt. & Pwr. Co. and will operate it in connection with its own system. J. Somerville is manager.

MOUNT RANIER, MD.—The town of Mount Ranier has engaged Harry Stevens, civil engineer, of Washington, D. C., to prepare plans for the installation of a municipal electric-light plant, for which bonds to the amount of $25,000 have been voted.

SALISBURY, MD.—Within the next 30 days the Salisbury Lt., Ht. & Pwr. Co. expects to purchase one 3000-hp water-tube boiler. John W. Downing is assistant manager.

WHEELING, W. VA.—Preparations are being made for extensive improvements and additions to the Wheeling Trac. Co.'s system. It is understood that a large part of the $6,500,000 secured on a bond issue will be used for expanding the railway system.

WASHINGTON, D. C.—A concession has been granted by a foreign government for the construction of an electric-light and tramway system for a certain city. The concession carries with it the privilege of utilizing falls which it is estimated will furnish 12,000 hp all the year, the current to be transmitted about 60 miles. Further information may be obtained by addressing No. 13,008, Bureau of Foreign and Domestic Commerce, Department of Commerce, Washington, D. C., and at the branch office, 315 Custom House, New York, N. Y.

WASHINGTON, D. C.—Bids will be received at the Bureau of Supplies and Accounts, Navy Department, Washington, D. C., until May 26 for furnishing at the various navy yards and naval stations the following supplies: Newport, R. I., Schedule 6722—two electrically heated baths. Washington, D. C., Schedule 6731—810 ft. four-way vitreous conduit, 800 ft. 500,000-circ. mil electric cable; Schedule 6748—4000 ft. plow-steel wire rope (¾ in. in diameter). Brooklyn, N. Y., Schedule 6725—one 24-in. motor-driven variable-speed upright drill, one motor-driven variable-speed screw-cutting tool-room lathe, one motor-driven variable-speed milling machine with overhanging arm; one motor-driven grindstone (30 in. in diameter, 4 in. face); Schedule 6740—six hot-wire, unshunted direct-reading 0-40-amp ammeters, 2600 ft. four-conductor, leaded or armored galvanized soft-steel interior-communication cable; Schedule 6739—miscellaneous seamless-drawn copper tubing; Schedule 6737—4000 ft. 150,000-circ. mil plain, single-conductor armoring and leading cable. Norfolk, Va., Schedule 6746—five electrically operated potato peelers. Portsmouth, N. H., Schedule 6743—one electric range. Bids will also be received until June 2 as follows: Mare Island, Cal., Schedule 6762—4100 lb. seamless-drawn copper pipe (12-in. lengths). Boston, Mass., Schedule 6764—two 10-in. suction, motor-driven, directly connected centrifugal fuel-oil pumping units. Applications for proposals should designate the schedule desired by number.

North Central

DRYDEN, MICH.—An electrical distributing system is being erected in Dryden. Electricity for operating the system will be furnished by the Schlegel Lt. & Pwr. Co., of Lapeer, 12 miles distant.

GRAND RAPIDS, MICH.—The contract for wiring the new Young Men's Christian Association building has been awarded to the Grand Rapids El. Co.

LAPEER, MICH.—At an election held April 6 the proposal to install a municipal electric-light plant to light the streets and public places in Lapeer was defeated. J. H. Brilwell is city clerk.

MONROE, MICH.—New bids will be received by the Board of Education until May 14 for electric wiring of old high-school building, which is to be remodeled throughout. Thomas R. Waters is secretary.

MOUNT CLEMENS, MICH.—The Eastern Michigan Edison Co. is negotiating for a new contract for lighting the city, the former contract having expired April 30. The company proposes to install in the business district steel posts equipped with flaming-arc lamps.

CLEVELAND, OHIO.—The Brooklyn municipal electric-light plant, it is understood, will be abandoned soon after the new municipal plant is completed and part of the machinery removed to the large plant. Connections will be made to give the West Side service from the new plant. The Collinwood plant will be continued to be operated until extensions are made to that section of the city.

DELPHOS, OHIO.—The Delphos El. Lt. & Pwr. Co. is extending its transmission lines to furnish electrical service to nearby towns. The company, it is understood, contemplates enlarging its power plant and to make further extensions to its service, including Van Wert, Grover Hill, Ottoville, Ohio City, Convoy and Middle Point.

EAST LIVERPOOL, OHIO.—The Council has directed J. J. Grafton, director of public service, to advertise for bids for electric and gas street-lighting service for a period of from two to five years. The question of establishing a municipal plant, for which $60,000 in bonds have been voted, is still held in abeyance on account of an injunction suit instituted by W. C. Conner.

MARION, OHIO.—Plans are being considered for the installation of cluster lamps in the business district.

MARYSVILLE, OHIO.—The Marysville Lt. & Wtr. Co. is contemplating the erection of 18 miles of transmission lines within the next 90 days. Wayne Mackan is superintendent.

MOUNT VERNON, OHIO.—The contract for the installation of an electric-light plant at the Knox County Infirmary has been

awarded to the Mount Vernon El. Co., at $2,586.

RAVENNA, OHIO.—The Ravenna Gas & El. Co. has applied to the Public Utilities Commission for permission to issue $75,000 in bonds, the proceeds to be used to reduce present indebtedness and for future improvements.

SYCAMORE, OHIO.—A petition has been presented to the Town Council asking the Council to issue bonds to remodel and repair the light and water plants.

TOLEDO, OHIO.—Bonds to the amount of $98,000 have been sold by the Toledo Trac., Lt. & Pwr. Co. The proceeds are to provide funds for extensions and betterments made to the generating and distributing system of the company.

ZANESVILLE, OHIO.—The City Council is considering the installation of ornamental lamps on Market Street as well as Main Street during the summer.

CENTRAL CITY, KY.—Plans are being prepared by S. J. Gish and James Small, of Central City; Hubert Meredith, of Greenville, and others for the construction of a large steam-driven electric plant on Green River, 3 miles from Central City, and to erect transmission lines to transmit electricity to more than 20 mining plants and other enterprises within a radius of 200 miles. The construction of steel coal tipples and concrete coal pockets is also contemplated. It is proposed to organize a company under the name of the South Kentucky Pwr. Co., in connection with the Central City, Greenville & Drakesboro Trac. Co., to operate the plant.

FRANKFORT, KY.—The City Council is considering substituting incandescent lamps for the arc lamps now in use for street lighting. The Kentucky Pub. Ser. Co. has the contract for street lighting.

HARRODSBURG, KY.—Within the next two months the electric light commissioners expect to install a motor-generator set to furnish energy for the water-works and one 30-hp, 2200-volt induction motor. The merchants expect to install an ornamental lighting system, consisting of about 40 lamp standards. Albert Riley is superintendent.

HODGENVILLE, KY.—C. L. Herron, of Liberty, who recently purchased the local electric-light system owned by D. E. Patterson, is planning to double the output of the plant. New equipment consisting of one boiler, engine and generator, 220-volt, direct current, will probably be installed. Mr. Patterson has on hand 14 1200-cp, 220-volt, direct-current arc lamps which he wishes to dispose of and will sell at a reasonable price.

LEITCHFIELD, KY.—The Leitchfield, El. Lt. Co. has purchased a site adjoining the tracks of the Illinois Central Railroad, on which it will begin at once the erection of a new power house. The new plant will be driven by steam power, the gasoline engines in the old plant having proved unsatisfactory. If sufficient patronage is guaranteed, the company will install a water-works system.

TAYLORSVILLE, KY.—M. F. Cheek, it is reported, is contemplating enlarging the electric-light plant and erecting a garage and repair shop.

ANDERSON, IND.—Plans have been completed by City Engineer Funk for the installation of an ornamental lighting system in the uptown district. The plans provide for 308 standards carrying five-lamp clusters, to cost about $30,000.

COLUMBUS, IND.—Plans are being considered to enlarge and improve the municipal electric-light plant in the near future.

FORT WAYNE, IND.—Bids will be received by the Board of Public Works until May 16 for the construction of a new power house for the municipal electric-light plant. Contracts for machinery have been awarded.

INDIANAPOLIS, IND.—The Board of Public Works has signed a contract with the Merchants' Ht. & Lt. Co., of Indianapolis, under which the company will light the streets of the city for a period of ten years, beginning April 15, 1915. The contract provides for the use of at least 2200 lamps, consisting of 10-amp alternating-current inclosed-flame carbon arc lamps, 100-watt series tungsten lamps outside of the underground district; five-lamp clusters (consisting of one 100-watt and four 60-watt tungsten lamps) and clusters of three 100-watt tungsten lamps on ornamental standards in the underground district; also to furnish electricity in all public buildings owned or controlled by the city. The cost of installing the system is estimated at $500,000.

JACKSONVILLE, IND.—The Indiana El. Trans. Co. has applied to the Public Service Commission for permission to dispose of its property to the Jasonville Wtr. & Lt. Co.

MARENGO, IND.—The installation of a municipal electric-lighting system in Marengo is reported to be under consideration.

MONTICELLO, IND.—The City Council has tentatively agreed upon a new ten-year contract with the Interstate Pub. Ser. Co. for street-lighting. Under the new contract the ornamental lighting system, consisting of 35 ornamental standards, carrying five-lamp clusters, is to be extended on Main Street and Broadway. The outside district is to be lighted by 50 100-watt lamps at street intersections.

RICHMOND, IND.—Within the next six months the city of Richmond expects to purchase 350 street lamps for the entire street-lighting system, the type of lamp not yet decided upon. C. A. Kleinknecht is superintendent.

ROCHESTER, IND.—The Rochester El. Lt., Ht. & Pwr. Co. is installing two 200-hp Sterling boilers. The company has just completed the installation of a 20-ton ice plant. C. A. Davis is superintendent.

ST. PAUL, IND.—Arrangements are being made to install an electric-lighting system in St. Paul. It is understood that the service will be furnished by the I. & C. Trac. Co., E. F. Gray representing the Hoosier El. Construction Co., which handles contract and wiring for the traction company, has secured a sufficient number of contracts to warrant the tapping or the high-tension line of the traction company.

TELL CITY, IND.—The managers of the municipal electric-light plant expect to change the system of the municipal electric-light plant from 133 to 60 cycles. F. H. Lehman is superintendent.

CHICAGO, ILL.—Bids will be received by John McGillen, clerk of the Sanitary District of Chicago, Room 700, 910 South Michigan Avenue, Chicago, until May 14, for furnishing compensators, with globes and fixtures complete, and nitrogen-filled series tungsten lamps. Bids will also be received at the same time and place for furnishing a steam-driven turbine and generator unit, with condensor and accessories, to be installed in the Thirty-ninth Street pumping station. For details see proposal columns.

EDWARDSVILLE, ILL.—Bids will be received by Harry J. Mackinaw, county clerk, Edwardsville, until June 4 for plumbing and electric wiring for the Madison County court house in Edwardsville. Plans and specifications are on file in the office of the county clerk, Edwardsville, or may be obtained from Robert G. Kirsch, 4067 Magnolia Avenue, St. Louis, Mo., for which a deposit of $50 will be required, to be refunded upon return of same.

FARMER CITY, ILL.—Within the next six months the electric-light commission expects to purchase generators, turbines, engines, material for distribution system, including transformers, poles, transmission towers, underground conduit, distribution cable, wire and meters; also within the next two months to purchase 40 single-lamp boulevard posts. Fred H. Reed is city clerk.

MACKINAW, ILL.—Within the next six months the Mackinaw El. Lt. Co. expects to purchase switches, protective devices and deep-well pump; also within the next 12 months to purchase transformers, poles, insulators, underground conduit, distribution cable, wire meters, incandescent lamps, posts, etc.; heating and cooking apparatus, vacuum cleaners, washing machines, wiring machines, switches, etc. F. E. Hart is general manager.

NAPERVILLE, ILL.—The Water and Light Department is now installing new equipment in the municipal electric-light plant. Oliver W. Strubler is chief clerk.

NAUVOO, ILL.—Within the next two months the Nauvoo El. Lt. & Pwr. Co. expects to purchase some transformers and meters. Joseph Nelson is manager.

FAIRCHILD, WIS.—The local electric-light plant, owned by the N. C. Foster Lumber Co., has been purchased by George B. Wheeler, general manager of the Chippewa Valley Ry., Lt. & Pwr. Co., of Eau Claire. The Chippewa Valley company, it is said, will erect a transmission line between Altoona and Fairchild, through Fall Creek and Augusta, 32 miles long, at a cost of about $50,000. Work on the erection of the line will begin within 30 days.

GLENWOOD, WIS.—The Glenwood & Downing Lt. & Pwr. Co., of Glenwood, has recently purchased a 75-kw generator, a 2½-kw exciter and switchboard equipment.

HAYWARD, WIS.—The Hayward El. Lt. & Pwr. Co. is reported to have awarded a contract to the Northwestern El. Equipment Co., of St. Paul, Minn., for the construction of a hydroelectric power plant, including machinery, generator and waterwheel complete. Under the terms of the contract the plant is to be completed by Aug. 1.

CHISHOLM, MINN.—Bids will be received by H. A. O'Brien, Chisholm, until May 13 for 216 100-watt, 220-volt tungsten lamps for the proposed ornamental street-lighting system.

HENNING, MINN.—We are informed that the village of Henning does not contemplate the construction of a municipal electric-light plant, as reported in the issue of April 25. The installation of a plant as a private enterprise is being considered. C. M. Anderson is secretary of the Henning Industrial Association.

LAKE CITY, MINN.—Bids will be received at the office of the supervising architect, Treasury Department, Washington, D. C., until June 10 for construction complete, including mechanical equipment, lighting fixures and approaches, of the United States post office at Lake City, Minn. Plans and specifications may be obtained from the above office or from the custodian of site. O. Wenderoth is supervising architect.

MADELIA, MINN.—Arrangements are being made for the installation of a new street-lighting system, consisting of 18 three-lamp clusters erected on ornamental standards and 47 standards carrying a single lamp, maintained by underground wires, to cost about $3,000. Contract has been awarded for the work.

MADISON LAKE, MINN.—The Consumers' Pwr. Co., of St. Paul, it is reported, is planning to erect a transmission line to Madison Lake, where the company has a contract to furnish electricity for lamps and motors and also for the city water-pumping station.

MINNEAPOLIS, MINN.—Bids will be received at the office of the supervising architect, Treasury Department, Washington, D. C., until June 10 for furnishing and installing special lighting fixtures in the new United States post office at Minneapolis, Minn. For details see proposal columns.

ELKADER, IA.—Within the next six months Schmidt Brothers & Co., of Elkader, expect to build a new concrete dam and to purchase a 250-kw, 2200-volt, alternating-current generator, a 75-kw motor and one 1300-hp waterwheel, with waterwheel governor and switchboard. H. M. Wolf is superintendent.

MINDEN, IA.—Bids will be received by Tewes Rohlfs, town clerk, until May 25 for the installation of an electric-light plant and distribution system. Fairbanks, Morse & Co., of Omaha, Neb., are engineers.

STORM LAKE, IA.—Application has been made to the City Council by A. W. Jones and O. A. Anderson, of Peterson, Ia., for a franchise to furnish electricity in Storm Lake.

WOOLSTOCK, IA.—The installation of an electric-light system in Woolstock is under consideration. The Council, it is reported, is negotiating with the city of Webster City, with a view of securing electricity from the municipal plant there.

CENTER, MO.—The Public Service Commission has granted the North Missouri Lt. & Pwr. Co. permission to erect transmission lines from Keokuk to Center, Perry and Frankfort, Mo., at a cost of $35,000, and substations at an additional cost of $15,000. The company will probably extend its line to New London, Mo.

CLAYTON, MO.—The County Court has granted the Missouri Pwr. & Service Co. a franchise to do business in Meramec, Bonhomme and Carondelet Townships for a period of 45 years. The company has erected a power plant on Big River in Jefferson County.

KANSAS CITY, MO.—Bids will be received by James B. Jackson, Jr., secretary board of directors of the school district, Kansas City, until May 14 for conduits, wiring, fixtures and other electrical work in the new Swinney School on Forty-second Street. J. H. Brady, 517 Finance Building, Kansas City, is chief engineer.

KOHOKA, MO.—The City Council has called an election to be held May 12 to vote on the proposal to issue $15,000 in bonds, $11,000 of which will be used for improvements to the municipal electric-lighting system.

OZARK, MO.—The Ozark Pwr. & Wtr. Co. has applied to the Public Service Commission for permission to issue $2,000,000 in bonds. David D. Hoag, of New York, N. Y., is secretary.

MAYVILLE, N. D.—Bids will be received until May 29 by Thomas A. Hillyear, president of the State Normal School, Mayville, for rewiring the main building of the normal school in accordance with plans and specifications prepared by Hancock Brothers, architects, Fargo, N. D. Plans and specifications may be seen at the office of the architects and at the Builders' Exchange in Grand Forks, N. D., and Minneapolis, Minn.

ALEXANDRIA, S. D.—Bonds to the amount of $16,000, it is reported, have been voted for the installation of an electric-light plant in Alexandria.

SPENCER, S. D.—The Spencer Lt. & Pwr. Co. has been organized to install and operate an electric-light system in Spencer. William Hoese is president and H. C. Leuth is secretary.

ALLEN, NEB.—Good Brothers have awarded the contract for the construction of a power house for an electric-light plant in Allen, to be situated near the pumping station.

PERU, NEB.—The Peru El. Lt. & Pwr. Co. expects to purchase within the next three months one small vacuum pump and a small amount of material for distribution system; also a few vacuum cleaners and washing machines. H. Hallenbeck is manager.

ARKANSAS CITY, KAN.—Bids will be received at the office of the supervising architect, Treasury Department, Washington, D. C., until June 4 for the construction complete, including mechanical equipment, interior lighting fixtures and approaches, of the United States post office at Arkansas City, Kan. Plans and specifications may be obtained at the above office or from the custodian of site at Arkansas City. O. Wenderoth is supervising architect.

BLUE RAPIDS, KAN.—The capital stock of the Marshall County Pwr. & Lt. Co. has been increased by $50,000, the proceeds to be used for improvements. The company, it is understood, has recently changed hands. The new officers are: E. A. Wharton, president; W. E. Ham, vice-president; William Hunter, secretary and treasurer, and B. F. Eyer, general manager.

KIOWA, KAN.—The city of Kiowa expects within the next two months to purchase one 125-hp oil engine, either belted or directly connected to a 75-kva, 60-cycle, 2300-volt generator. A. Jones is superintendent.

MOUND CITY, KAN.—Application has been made to the City Council by Orville Wright, of Walnut, for a franchise to install and operate an electric-light plant and ice factory in Mound City.

OTTAWA, KAN.—The Home Tel. Co., it is reported, is contemplating the construction of a new plant, to cost $75,000, if sufficient inducements are offered. C. F. Adams, of Kansas City, is vice-president.

SUMMERFIELD, KAN.—The city of Summerfield has entered into a contract with the city of Pawnee, Neb., whereby the latter will supply electricity from the municipal electric-light plant in Pawnee for the proposed electric-lighting system for this city, for which bonds to the amount of $12,000 have been voted. Henry Maitland is city clerk.

Southern States

ELKIN, N. C.—The contract for construction of the municipal electric-light plant has been awarded to the J. B. McCrary Co., of Atlanta, Ga. The equipment will consist of one 200-hp waterwheel, one waterwheel governor, one 100-kw generator, switchboard, four 50-kw, 6600-volt to 2300-volt transformers and one out-door substation; 4 miles of overhead-line material will be required. No. 6 conductor will be used.

MURFREESBORO, N. C.—The installation of a municipal electric-light plant, to be operated by water-power, is reported to be under consideration.

ROCKY MOUNT, N. C.—Bids will be received at the office of the supervising architect, Treasury Department, Washington, D. C., until May 29, for construction, including mechanical equipment, interior lighting fixtures and approaches, of the United States post office at Rocky Mount. Drawings and specifications may be obtained at the above office or from the custodian of site at Rocky Mount. O. Wenderoth is supervising architect.

BRUNSWICK, GA.—The Mutual Lt. & Wtr. Co., of Brunswick, expects to erect within the next 12 months a new 500-kw generating plant, 2300 volts, 60 cycles. J. M. Armstrong is superintendent.

CANTON, GA.—The proposal to issue bonds to enlarge the municipal electric-light plant and water-works system will soon be submitted to the voters.

CHATSWORTH, GA.—The city is contemplating the installation of a municipal electric-light plant.

DARIEN, GA.—Within the next 12 months the Darien Ice & Lt. Co. expects to purchase a small amount of material, including lightning arresters, wire, meters, incandescent lamps and wiring supplies. Charles M. Tyson is secretary and treasurer.

WINDER, GA.—The Water and Light Commissioners within the next 18 months expect to install an additional steam engine and probably a generator in order to establish a day service. Nothing definite has been decided upon. H. N. Rainey, Jr., is clerk.

APOPKA, FLA.—The installation of a municipal electric-light plant is reported to be under consideration.

PUNTA GORDA, FLA.—The city of Punta Gorda may possibly purchase within the present year a series street-lighting system (about 10-kw capacity). E. W. Lawson is city electrician.

MEMPHIS, TENN.—The Illinois Central R. R. Co., it is reported, is planning to erect a power house in Memphis, 37 ft. by 76 ft., one story and basement, at a cost of $15,000. A. S. Baldwin, of Chicago, Ill., is chief engineer.

FRIENDSHIP, TENN.—It is reported that R. T. Coffman, owner of the local electric-light plant, contemplates increasing the output of his power house.

PULASKI, TENN.—Bids will be received at the office of the supervising architect, Treasury Department, Washington, D. C., until May 27, for the construction, including mechanical equipment, lighting fixtures and approaches, of the United States post office at Pulaski, Tenn. Drawings and specifications may be obtained at the above office or from the custodian of site at Pulaski. O. Wenderoth is supervising architect.

LEEDS, ALA.—The Council has granted W. M. Hood and associates a franchise to install an electric-light plant in Leeds.

TUSKEGEE, ALA.—The contract for the construction of central heating, and lighting plant, sewer system and sewage disposal plant for the Tuskegee Normal and Industrial School has been awarded to the Ford Construction Co., 105 West Fortieth Street, New York, N. Y. Walter G. Franz, Union Trust Building, Cincinnati, Ohio, is consulting engineer.

LAKE CITY, ARK.—The Lake City Commercial Club is interested in a project to establish an electric-light plant in Lake City. John W. Scobey is secretary of the club.

LITTLE ROCK, ARK.—Bids will be received by the Arkansas State Capitol Commission, State Capitol, Little Rock, until June 2 for furnishing and installing complete in the Capitol Building certain furniture, fixtures, lighting fixtures, steel vault equipment, etc., in accordance with plans and specifications on file in the office of the commission, copies of which can be obtained upon application to the commission, for which a deposit of $25 will be required, to be refunded upon return of same. John I. Moore is chairman of commission.

MAGAZINE, ARK.—J. L. Roberts, recently granted a franchise to furnish electricity in Magazine, has contracted with Greenaway & Harvey, of Booneville, to furnish electricity to operate the proposed system here. A transmission line is now being erected between the two towns, and as soon as completed a 24-hour service will be established.

NEWPORT, ARK.—Bids will be received at the office of the supervising architect, Treasury Department, Washington, D. C., until June 8 for the construction complete, including mechanical equipment, lighting fixtures and approaches, of the United States post office at Newport, Ark. Drawings and specifications may be obtained at the above office or from the custodian of site at Newport. O. Wenderoth is supervising architect.

MUSKOGEE, OKLA.—Bids will be received at the office of the supervising architect, Treasury Department, Washington, D. C., until June 5 for furnishing and installing lighting fixtures in the United States post office and court house at Muskogee. For details see proposals columns.

PAULS VALLEY, OKLA.—The Washita El. Pwr. Co., of Pauls Valley, is considering the installation of 200-kw generating unit, consisting of a generator directly connected to a Corliss engine. R. K. Johnston is secretary and treasurer.

WILSON, OKLA.—The installation of an electric-light plant in Wilson is under consideration. W. J. Whitely is reported interested in the project. Post office address, Homestead, Okla.

HOUSTON, TEX.—The Houston Harbor Board is considering plans for developing terminals at the turning basin of the Houston ship channel. Tentative plans have been submitted by J. F. Coleman, engineer, including the erection of an electric power plant and other equipment in addition to the warehouse, docks, etc.

LAREDO, TEX.—The Interstate El. Corpn., of New York, N. Y., it is reported, has purchased the electric-light plant and water-works system of the Laredo Wtr. Co., the consideration being $253,000.

Pacific States

CONCONULLY, WASH.—The County Commissioners have granted the Okanogan Valley Pwr. & Lt. Co., of Spokane, permission to erect and operate transmission lines along State Road No. 10, from Brewster to Omak, for a period of 35 years. The company has begun work for rehabilitating its power plant at Peteros, which will include the installation of considerable new machinery.

PORT ANGELES, WASH.—The City Council has granted the Olympic Pwr. Co., of Port Angeles, permission to erect a 60,000-volt transmission line from its main transmission line on the boulevard to its intersection at Third Street, where a substation will be erected. The company also contemplates other improvements in and near this city.

SPOKANE, WASH.—The Spokane Valley Pwr. Co., it is reported, will increase its capital stock from $200,000 to $2,000,000, the proceeds to be used for developing a power site below Fort Wright. For further information address W. A. Corey, care of the Finch Investment Co., of Spokane.

ASTORIA, ORE.—Bids will be received at the office of the supervising architect, Treasury Department, Washington, D. C., until June 15 for miscellaneous changes in hydraulic lift, pumping plant, etc., in the United States custom house at Astoria. For details see proposal columns.

FOSSIL, ORE.—The property of the Fossil El. Lt. Co. has been purchased by M. Dittmer, of Spokane, who, it is said, will make improvements and extensions to the plant.

MEDFORD, ORE.—The California & Oregon Pwr. Co., of Medford, Ore., is planning to extend its transmission lines into Douglas County and adjacent territory. The company has purchased the electric plant in Glendale and will furnish electricity in that town and also to farmers to operate pumps for irrigating purposes.

MILTON, ORE.—The Walla Walla River Pwr. Co. recently incorporated with a capital stock of $120,000, is securing deeds, easements and right-of-way on the Walla Walla River, preparatory to the construction of an electric-light plant. Capitalists of Walla Walla and Milton are interested in the project.

TOLEDO, ORE.—The local telephone system has been purchased by A. Welch, of Portland, and W. H. Wehrung, of Hillsboro. The new owners will extend the line from Toledo to Newport, and will also erect a metallic system with copper wires from Newport to the Valley. The old lines in this vicinity will be replaced with copper wire; a new switchboard will be installed in Toledo.

CHICO, CAL.—Bids will be received at the office of the supervising architect, Treasury Department, Washington, D. C., until June 9 for the construction, including mechanical equipment, lighting fixtures and approaches, of the United States post office at Chico, Cal. Drawings and specifications may be obtained at the above office or from the custodian of site at Chico. O. Wenderoth is supervising architect.

ESCONDIDO, CAL.—Plans, it is reported, are being prepared for two hydroelectric power plants for the Escondido Mutual Wtr. Co.

VISALIA, CAL.—The Mount Whitney Pwr. & El. Co., of Visalia, has applied to the State Railroad Commission for permission to issue $500,000 in bonds, the proceeds to be used for additions and betterments as follows: For the Wolverton dam, $112,000; extensions, $315,000; steam plant, $50,000, and on hydraulic plant No. 5, $25,000.

LEWISTON, IDAHO.—A committee has been appointed by the Mayor to investigate the feasibility of the power site on the Clearwater River, where the city is considering the establishment of a municipal hydroelectric power plant, to cost about $500,000.

MEADOWS, IDAHO.—Within the next 12 months Goodman & Chisholm, owners of the local electric-light plant, expect to purchase generators, switches, waterwheel governors, transformers, poles, lightning arresters, insulators, wire, meters; also electrical supplies, including heating and cooking apparatus and wiring supplies. A. A. Loodman is manager.

WEISER, IDAHO.—The Adams County Lt. & Pwr. Co., of Weiser, has applied for a permit at the Ogden district of forestry service for permission to erect a power plant on Rush Creek, north of Weiser, in the Weiser national forest, to cost about $20,000. The company proposes to furnish elec-

tricity in Midvale, Canbridge and other towns in the Weiser Valley.

BRIGHAM CITY, UTAH.—Bids will be received at the office of the supervising architect, Treasury Department, Washington, D. C., until June 1 for the construction complete, including mechanical equipment, interior lighting equipment and approaches, of the United States post office at Brigham City. Drawings and specifications may be obtained from the above office or from the custodian of site at Brigham City. O. Wenderoth is supervising architect.

BAKER, MONT.—E. G. Heinrich, of Baker, has applied to the Town Council for a franchise to install and operate an electric-light plant here.

LAUREL, MONT.—We are informed that the Council has abandoned the proposal to install an electric street-lighting system in Laurel.

HURLEY, N. M.—The Chino Copper Co. is contemplating enlarging its electric power plant in Hurley.

Canada

MEDICINE HAT, ALTA.—Plans are being considered by the Ogilvie Flour Mills Co., of Medicine Hat, for the installation of electrical power in its mill, to replace gas engine now in use. About 1300 hp will be required.

MEDICINE HAT, ALTA.—The City Council contemplates carrying on a series of tests to determine the type of lamp to use for street-lighting, and to that end is installing two or three flaming-arc lamps, luminous-arc lamps and also an improved gas lamp. A. K. Grimmer is city engineer.

RED CLIFF, ALTA.—The Council has passed a by-law providing for cement sidewalks and the installation of cluster lamps on Broadway and Third Streets.

VEGREVILLE, ALTA.—The Town Council has authorized plans prepared for the installation of a municipal electric-light plant, bonds for which have been voted.

SHOAL LAKE, MAN.—Tenders will be received by F. Doobs, secretary and treasurer, until May 28 for construction of an electric-light plant as follows: (1) Furnishing and installing semi-Diesel oil engine; (2) direct-current generator, booster and switchboard; (3) storage battery; (4) construction of concrete and frame power station; (5) equipment for distribution system, including poles, line supplies, copper wire,, direct-current meters and equipment for tungsten street lamps; (6) erection of pole line. Plans and specifications may be seen at the office of the John Galt Engineering Co., at Winnipeg, Man., and Calgary, Alta., and at the Town Hall, Shoal Lake. A deposit of $25 will be required on contracts Nos. 4 and 5, which will be refunded upon return of same.

WINNIPEG, MAN.—It is reported that tenders will be received until May 23 for boilers and stokers for the new power house in Winnipeg. Plans and specifications may be obtained from the provincial architect, 261 Front Street, Winnipeg. Tenders will also be received until May 22 for furnishing induction feeder regulators, specifications for which may be obtained from the Light and Power Department, 54 King Street, Winnipeg.

CHATHAM, ONT.—Engineer Jeffrey of the Hydro-Electric Commission has suggested to the City Council that the city erect a power plant, at a cost of about $89,000.

EMBRO, ONT.—The ratepayers on April 24 voted in favor of the by-law authorizing the Council to contract with the Hydro-Electric Power Commission for hydroelectric power in Embro.

OTTAWA, ONT.—United States Consul-General Foster, at Ottawa, has sent information to the State Department at Washington that American capitalists have purchased extensive water-power privileges extending along the Saguenay River from Lake St. John to tidewater in the Province of Quebec. It is said that about 300,000 electrical hp will be developed, to be used in connection with a hydroelectric fertilizer plant for the production of phosphoric-acid fertilizer in electric furnaces.

TORONTO, ONT.—Estimates for the year provide funds for 8000 additional new lamps for the street-lighting system.

TORONTO, ONT.—Tenders will be received by the Hydro-Electric Power Commission, Continental Life Building, Toronto, until May 18 for construction of dams, headworks, etc., and for excavation of a canal in connection with a power development at Eugenia Falls, and specifications may be seen and form tender obtained at the office of the commission. Copies of plans and specifications may be obtained upon deposit of $5, to be refunded upon return of same. W. W. Pope is secretary of commission.

WELLAND, ONT.—The Town Council has made application to the Hydro-Electric Power Commission of Ontario to make a survey here and report on hydro-radials. United action is planned by all the municipalities in the Niagara peninsula and a network of radial railways to cover the district will be the result. St. Catharines and Port Colborne have made application.

WOODSTOCK, ONT.—The water and light commissioners are considering the erection of a small substation and the purchase of necessary transformers to take care of the increasing demands in the northwest section of the city.

BELŒIL, QUE.—The contract for the installation of an electric distributing system in Belœil has been awarded to Armours, Ltd., of Quebec. The Southern Canada Pwr. Co. is erecting a transmission line from Richelieu to the outskirts of Belœil, and the municipality will continue this line through the town, a distance of 5 miles. Energy supplied by the Montreal Lt., Ht. & Pwr. Co. over the 50,000-volt transmission line will be stepped down to 2300 volts in the substation at the town line. The street-lighting system will consist of 100 tungsten lamps of 80 cp, connected by goose brackets. On the primary line No. 4 double-braided, weatherproof wire will be used, and for secondary line No. 6 wire will be used.

MONTREAL, QUE—The Southern Canada Pwr. Co. is constructing a 50,000-volt transmission line from Richelieu to Sherbrooke, Que. At present the line will be extended to St. Hyacinthe, but eventually it is planned to continue it to Drummondville and Sherbrooke. The company recently acquired the plants and properties of the South Shore Co. the St. Hyacinthe Gas & El. Co. and the St. John's El. Co., and it also controls three water-power sites on the St. Francis River, near Drummondville, which it is estimated will develop 30,000 hp. It is proposed eventually to link these various plants into one system. Part of the energy is to be supplied by the Montreal Lt., Ht. & Pwr. Co. J. M. Robertson, of Montreal, is consulting engineer.

STE. AGATHE, QUE.—Arrangements are being made by the municipality of Ste. Agathe for the installation of a hydroelectric plant on the North River. The plant will have an output of 500 hp. The equipments will include two generating units of 250 hp. Horizontal turbines manufactured by the Canadian Allis-Chalmers Co., directly connected to 150-kva alternating-current generators, will be used. Contracts for power house and machinery have been awarded. Ouimet & Le Sage, of Montreal, are engineers.

WESTMOUNT, QUE.—The City Council is proceeding with the installation of a new street-lighting system. An appropriation of $8,000 has been voted for additional 6.6-amp magnetite-arc lamps and standards; the sum of $10,000 will also be provided for laying underground conduits, the work to be done by the city.

ESTEVAN, SASK.—Negotiations, it is reported, have been completed between the Town Council and the Estevan Brick & Coal Co., whereby the latter will furnish electricity to the town. The cost of the company's plant is estimated at $100,000.

WEYBURN, SASK.—The installation of an additional engine and generator in the municipal electric-light plant is under consideration; also the erection of a steel smokestack.

Miscellaneous

FAIRBANKS, ALASKA.—Water rights on the Nenana River have recently been acquired by John L. Timmins, through local agents, where it is understood a power plant will be built by a company in which Mr. Timmins is interested. It is understood that work will begin on the development during the coming summer.

PANAMA.—Bids will be received at the office of the general purchasing officer, Panama Canal, Washington, D. C., until May 16 for furnishing electric cable, insulating tape, valve-pit and gutter covers, gratings, etc. Blanks and general information relating to this circular (No. 848) may be obtained from the above office or from the offices of the assistant purchasing agents, 24 State Street, New York, N. Y.; 614 Whitney-Central Building, New Orleans, La., and 1086 North Point Street, San Francisco, Cal. Major F. C. Boggs is general purchasing officer.

PANAMA.—Bids will be received at the office of the general purchasing officer, Panama Canal, Washington, D. C., until May 23 for furnishing switchboards, linoleum and lumber. Blanks and general information relating to this circular (No. 851) may be obtained from the above office and from the office of the assistant purchasing agents, 24 State Street, New York, N. Y.; 614 Whitney-Central Building, New Orleans, La., and 1086 North Point Street, San Francisco, Cal. Major F. C. Boggs is general purchasing officer.

MANILA, P. I.—The Manila R. R. & Lt. Co. is expecting to make extensions to its distributing system within the next 12 months requiring overhead material, including wire, insulators, transformers, meters, etc., to cost about $10,000; also will purchase a small stock of electrical appliances and supplies. C. N. Duffy is vice-president.

New Incorporations

NEW HAVEN, CONN.—The Southern New England Pwr. Co. has been incorporated with a capital stock of $100,000 by Randall J. Everett and Fred J. Apple, of New York, and Edwin H. McHenry, of New Haven. This company will take charge of the water-power development of the New York, New Haven & Hartford R. R. Co.

RUPERT, IDAHO.—The Farmers' El. Co. has been chartered with a capital stock of $3,000 for the purpose of furnishing electricity for lamps and motors. The officers of the company are: M. T. McDermott, president; J. A. Plowman, vice-president, and J. M. Butler, secretary and treasurer.

EAGLE GROVE, IA.—The Evergreen Mutual Lt. & Pwr. Co. has been incorporated with a capital stock of $10,000. The company proposes to construct and maintain an electric transmission in Wright and adjoining counties.

GLIDDEN, IA.—The North Glidden El. Co. has been organized to furnish electricity to farmers and residents north of Glidden from the municipal electric plant. At least 10 miles of lines will be erected. The officers are: George Juergens, president; J. G. Robson, vice-president, and J. G. Merritt, secretary and treasurer.

LOUISVILLE, KY.—The Southern Utilities Co. has been incorporated with a capital stock of $10,000 by M. H. Thatcher, J. F. Taylor and W. G. F. Dearing. The company proposes to construct and operate electric-light and power plants and other utilities.

MAPLETON, MAINE.—The Mapleton El. Co. has been organized with a capital stock of $5,000 for the purpose of furnishing electricity for lamps and motors in Mapleton, Castle and in Chapman Plantation. The officers are: A. E. Floyd, of Mapleton, president; H. M. Hughes, secretary, and Aubrey C. Frost, of Limestone, treasurer.

KNOBNOSTER, MO.—The Knobnoster Brick, Tile, Lt. & Pwr. Co. has been incorporated with a capital stock of $40,000 by C. A. Harrison, Charles D. Littleton and J. B. Quinlan.

SULLIVAN, MO.—The El. Lt. & Pwr. Co. has been incorporated with a capital stock of $25,000 by Richard Zinkmann, E. W. Illien and W. E. Anderson.

NEW YORK, N. Y.—The Columbia Mills Pwr. Co. has been incorporated with a capital stock of $500,000 by T. D. McChesney, 27 West Twenty-fourth Street, New York; W. R. Hees, of New York, and G. H. Hees, of Toronto, Can. The company proposes to furnish electricity for lamps and motors.

SAG HARBOR, N. Y.—The Long Island Gas Corporation has been incorporated with a capital stock of $100,000 by H. F. Cook, of Sag Harbor; H. A. Odell, of New York, and G. E. Fahys, of Locust Valley. The company proposes to supply gas and electricity for lamps, heaters and motors in Suffolk and Norfolk Counties.

ELKIN, N. C.—The Center Falls Pwr. Co. has been granted a charter with a capital stock of $25,000 for the purpose of developing water-power at Central Falls, near Elkin, at a cost of $20,000. The work will include diverting dam, power house, transmission system, etc. The incorporators are A. W. Smith, R. H. Chatham and others.

TULSA, OKLA.—The Drumright Lt. & Ice Co. has been incorporated with a capital stock of $30,000 by Charles F. Petty and Orville Knight, of Kiefer.

RICHMOND, VA.—The National Securities Corpn. has been chartered with a capital stock of $25,000,000 and the following officers: Murray McGuire, president; Thomas P. Bryan, vice-president, and John S. Eggleston, secretary and treasurer. The company proposes to construct, equip, improve plant for generating, storage and supplying electricity, gas, water or steam power.

Weekly Record of Electrical Patents

UNITED STATES PATENTS ISSUED APRIL 28, 1914.

[Prepared by Robert Starr Allyn, 16 Exchange Place, New York, N. Y.]

1,094,438. Glass Tubing; H. S. Hatfield, Jena, Germany. App. filed March 18, 1911. Mercury tube provided with an internal groove in which a wetting fluid flows.

1,094,439. Means for Measuring the Rate of Movement of a Mechanism Averaged Over Any Predetermined Period of Time; H. S. Hatfield, Jena, Germany. App. filed April 1, 1911. Maximum-demand electrical indicator.

1,094,441. Block-Signal System; L. A. Hawkins, Schenectady, N. Y. App. filed May 10, 1909. All relays of the efficient two-winding type.

1,094,479. Switch Plug; H. R. Sargent, Schenectady, N. Y. App. filed Jan. 31, 1913. Rotary snap switch mounted on the base of the plug.

1,094,487. Ship's Course-Recording Device; F. Spalazzi, Rome, Italy. App. filed May 28, 1908. Ship's course is recorded on a drawing sheet or directly upon a sea chart.

1,094,494. Electric Railway; L. H. Thullen, Edgewood Park, Pa. App. filed May 20, 1905. Connected cross-bonds at the adjoining ends of block sections.

1,094,495. Signaling System for Railways; L. H. Thullen, Edgewood Park, Pa. App. filed Oct. 14, 1905. Special track circuits.

1,094,506. Electric Iron; H. Wicks, Cleveland, Ohio. App. filed Jan. 2, 1914. Terminals supported so as not to become heated when iron is in use.

1,094,507. Manufacture of Woven Wire Fabric; T. H. Wickwire, Cortland, N. Y. App. filed Feb. 6, 1912. Electroplates the woven fabric.

1,094,534. Electric Switch; R. H. Conrad, Oakland, Cal. App. filed Jan. 18, 1913. For starting alternating-current motor with its windings in star relation and switching over to delta arrangement.

1,094,539. Process of Producing 1,3 Butyleneglycol; K. Delbrück and K. Meisenburg, Elberfeld, Germany. App. filed Jan. 21, 1913. Electrolytic reduction of aldol in dilute sulphuric-acid solutions.

1,094,562. Electric Switch; O. H. H. Heins, Edgewater, N. J. App. filed June 30, 1909. Lock switch for controlling the usual two sets of ignition plugs.

1,094,563. Collector; A. Helfenstein, Vienna, Austria-Hungary. App. filed March 31, 1913. Paramagnetic contact rail or car engages flexible paramagnetic brush member suspended above car.

1,094,584. Signaling Device; M. S. Morse, Oakland, Cal. App. filed May 11, 1912. Operated by vibration of the track rail.

1,094,607. Automatic Card-Exhibiting Device; J. C. Smith, Kansas City, Mo. App. filed Oct. 10, 1911. Card is brought into view when pen is dipped into inkwell.

1,094,609. Typewriting Machine; J. Sokolov, New York, N. Y. App. filed Feb. 25, 1911. Carriage returned at high or low speed dependent upon length of line.

1,094,618. Apparatus for Treating Fluids; H. T. Weston, Cleveland, Ohio. App. filed May 1, 1911. Treating gases to silent discharges or other emanations produced by electricity.

1,094,689. Indicating Systems for Turrets; F. W. Wood, New York, N. Y. App. filed Aug. 8, 1910. Visible indication is given at all times of the angular position of one turret with respect to the next adjacent turret.

1,094,690. Switch; F. W. Wood, New York, N. Y. App. filed Dec. 22, 1910. In watertight casing for marine purposes.

1,094,691. Electrical Switch; F. W. Wood, New York, N. Y. App. filed Aug. 2, 1912. System of transmitting and indicating units for ship's telegraph.

1,094,692. Explosive-Cap Protection; C. H. Allison, Glendale, Cal. App. filed June 28, 1913. Envelope protects cap against loss of the power of detonation.

1,094,693. Oil Switch; J. M. Anderson, Boston, Mass. App. filed July 23, 1908. High potential; reduces danger of shocks.

1,094,694. Oil Time Switch; J. M. Andersen, Boston, Mass. App. filed July 23, 1908. For high potential; supplied as a single compact structure.

1,094,699. Safety Device for Overhead Electric Lines; F. F. Bourdil, Paris, France. App. filed Dec. 21, 1910. For rendering the wire harmless in case of its breaking.

1,094,711. Electric Motor; E. M. Fraser, Yonkers, N. Y. App. filed May 22, 1911. Particularly for "traction" elevators.

1,094,714. Reciprocating Heater; W. S. Hadaway, Jr., New Rochelle, N. Y. App. filed March 11, 1913. Fluid heater having receptacles connected by interposed heat-radiating means with electrical means alternately supplying heat to the receptacles.

1,094,717. Coupling for Electric Conductors; J. L. Hinds and J. J. Dossert, Syracuse, N. Y. App. filed May 26, 1909. Double clamp for securing a wire to an angularly disposed conductor.

1,094,718. Electric Condenser and Method of Constructing the Same; G. Honold, Stuttgart, Germany. App. filed Sept. 25, 1911. Unites by cold pressure layers of conducting material with interposed thin layers of dried cohesive insulation solution.

1,094,728. Electrolytic Apparatus; I. H. Levin, Newark, N. J. App. filed May 9, 1913. Diaphragm apparatus for dissociating the oxygen and hydrogen entering into an electrolyte.

1,094,732. System of Distribution; F. W. Lyle, Lynn, Mass. App. filed Sept. 18, 1912. For street-car lighting systems.

1,094,733. Electric Regulator; F. W. Lyle, Lynn, Mass. App. filed Sept. 18, 1912. Filamentary boron resistor with heater in parallel and heat-conveying relation thereto.

1,094,743. Street or Station Indicator; J. L. Olson, St. Paul, Minn. App. filed Dec. 18, 1911. Motor projects the indicating ribbon or sheet step by step.

1,094,745. Electric Incandescent Lamp; J. W. Phelps, Detroit, Mich. App. filed Feb. 17, 1904. Multi-filament lamp with lever switch operated by pull cords in the base thereof.

1,094,771. Electrically Heated Oven; H. P. Ball, Pittsfield, Mass. App. filed March 17, 1913. Resistance heating units mounted so that they may be swung to vertical or horizontal position.

1,094,774. Process of Making Incandescent Electric Lamps; A. Berliner, Berlin, Germany. App. filed Dec. 1, 1908. Prevents at all times any great absorption of gases by the glass walls.

1,094,778. Vapor Electric Apparatus; A. Churchward, New York, N. Y. App. filed Jan. 18, 1904. For starting and controlling rectifier and the like.

1,094,789. Push-Button Support for Motor Vehicles; O. W. Hunt, Detroit, Mich. App. filed July 19, 1910. For detachably clamping the push-button on the steering wheel.

1,094,798. Safety Switch for Motor Vehicles; W. MacGlashan, South Bend, Ind. App. filed Feb. 5, 1913. For electric vehicles; only in the neutral position of the controller can the safety switch be closed.

1,094,806. Switch; W. J. Newton, Lynbrook, N. Y. App. filed Nov. 15, 1912. The exposed contacts in the receptacle do not receive current until the plug has been inserted therein.

1,094,819. Self-Playing Violin; H. K. Sandell, Chicago, Ill. App. filed Aug. 5, 1913. Fingering mechanism extends along one side of the neck of the instrument.

1,094,829. Electrical Insulator; J. W. Aylsworth, East Orange, N. J. App. filed March 17, 1911. Distilled chloro-naphthalene treated with an alkali.

1,094,839. Flashlight Device; R. M. Eaton, Niagara Falls, N. Y. App. filed Oct. 2, 1913. Circuit-closing member is protected by being placed inside the battery casing.

1,094,851. Electric Resistance Device; W. S. Hadaway, Jr., New York, N. Y. App. filed Nov. 20, 1911. Having high resistance by means of which heat is readily radiated.

1,094,852. Insulator Pin; J. L. Hecht and J. C. Gapen, Oak Park, Ill. App. filed Aug. 4, 1911. Has strain-taking base held in position by a bolt passing through the cross-arm.

1,094,870. Trolley Guard; J. H. Boyd, Carlisle, Pa. App. filed Oct. 11, 1913. Spring arms form the harp.

1,094,903. Storage Battery Electrode and Process of Manufacturing It; H. C. Hubbell, Newark, N. J. App. filed July 17, 1911. Iron storage-battery electrode.

1,094,907. Locking Device for Electrical Contacts; J. De R. Kielland, Christiania, Norway. App. filed Dec. 12, 1911. Helical spring forms the threads to receive the lamp base.

1,094,910. Corrugated Welding Strip; L. S. Lachman, New York, N. Y. App. filed Aug. 9, 1913. Forming a plurality of connected welding pieces.

1,094,912. Electric Furnace; T. Levoz, Heer, Belgium. App. filed Sept. 3, 1910. For manufacturing "electro-steel."

1,094,916. Trolley Catcher and Retriever; C. W. Merrill, Los Angeles, Cal. App. filed Oct. 22, 1909. Combination of weight and a clutch which is brought into operation by a sudden jerk on the trolley line.

1,094,918. Block-Signal System; J. W. Murphy, Akron, Ohio. App. filed April 29, 1912. Signalman prevented from operating his signal without the co-operation of the signalman at the next station.

1,094,973. Vehicle-Controlling Apparatus; T. Bodde, Brant Rock, Mass. App. filed Aug. 22, 1908. Train magnet co-operates with stationary magnet device.

1,094,990. Branch Box; M. Havens, Jr., Albany, N. Y. App. filed May 20, 1911. Has perforated insulators non-rotatably held to the box.

1,094,991. Thermostat; R. E. Hinson, Hillsboro, Tex. App. filed March 8, 1913. For controlling a radiator and the like.

1,095,007. Blind Shaft Bearing for the Driving Means of Electric Locomotives; G. Lundholm, Vesteras, Sweden. App. filed Jan. 30, 1914. Movable in a vertical direction and immovable in horizontal direction.

1,095,084. Signal Apparatus; V. J. Crettol, Chicago, Ill. App. filed June 3, 1913. For rural mail boxes.

1,095,112. Annunciator System; T. A. Haugaard, Cheyenne, Wyo. App. filed Oct. 29, 1913. Whereby guests in any room or number of rooms may be called at any desired time or times.

1,095,114. Device for Controlling Elevators; W. E. Brown, New York, N. Y. App. filed May 21, 1913. Prevents starting of car when door is open.

1,095,118. Device for the Production of Induced Currents in Magneto Machines and Dynamos; A. Kellar-Dorian, Lyons, France. App. filed Dec. 7, 1912. Polarized flanges may be displayed to produce variations of flux in the coil.

1,095,121. Cooling Device for Röntgen Tubes; J. A. Mannheim, Hamburg, Germany. App. filed Dec. 12, 1911. Air is used as cooling agent.

1,095,135. Fuse Holder; H. W. Young, Chicago, Ill. App. filed Jan. 10, 1913. Fuse can only be used when fully assembled.

1,095,138. Push Switch; C. A. Bates, Bridgeport, Conn. App. filed June 26, 1913. Pendent type.

1,095,170. Alternating-Current Rectifying Apparatus; C. P. Steinmetz, Schenectady, N. Y. App. filed March 23, 1903. High-voltage or low-voltage current may be rectified without apparatus having moving parts.

1,095,175. Mercury-Vapor Lamp; R. Küch, Hanau, Germany. App. filed Feb. 3, 1910. Hollow quartz glass receptacles introduced into the electrode chambers.

1,095,178. Mechanism for Controlling the Speed of Turbines or Other Prime Movers Connected in Parallel; H. E. Warren, Ashland, Mass. App. filed Sept. 25, 1911. Series of governors responsive to pressure of system and independently responsive to speed of units they control.